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MAGNETIC SEPARATOR
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2,968,402

FIG. 1

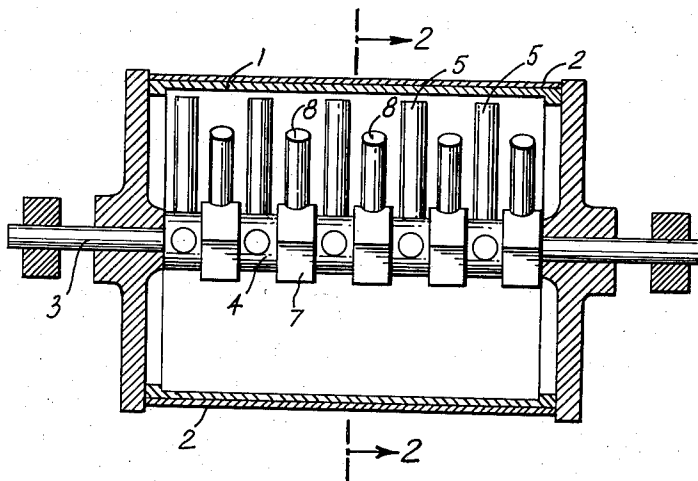
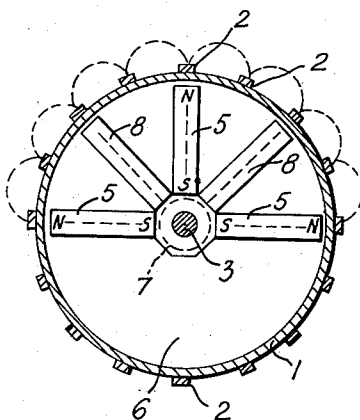


FIG. 2



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This invention relates to a drum-shaped part-magnetic separator for continuously separating ferro-magnetic or magnetizable particles from a dry or wet mixture of such particles with non-magnetizable particles. This is a continuation-in-part application of my copending application Serial No. 495,894, filed March 22, 1955, now abandoned, which is a continuation-in-part application of my application Serial No. 186,728, filed September 26, 1950, now Patent No. 2,707,557.

In such a part-magnetic separator a non-magnetic drum is rotatable about a magnet system arranged within the drum in such a manner that the drum is thereby divided into a magnetically effective peripheral portion and a complementary magnetically ineffective portion.

The invention aims to improve, for example, the efficiency of those separators in which the magnetic system consists of an even number of rod-shaped permanent magnets and a ferro-magnetic or magnetizable plate connecting the magnets and having the shape of a sector covering part of the inner surface of the drum. The permanent magnets are connected with the sector plate in such a manner that the latter shows the magnetic zero potential whereas the magnetic circuit is closed by the drum shell or by the materials to be separated. Ferro-magnetic or magnetizable bodies which are covered by the drum shell and ferro-magnetic particles adhering thereto are separated on that side of the separator which is opposite to the magnetic rods within the effective range of the sector plate.

However, the effectiveness of separation of such prior separators is not satisfactory, particularly so where the particles to be separated are small. The reason is that the sector-shaped plate has a magnetic zero potential only in the range where the magnets having uneven polarities are located directly next to one another, whereas the opposite zones of the plate show magnetic dispersion which makes the non-magnetic range of the plate comparatively small, leaving the non-magnetic and the magnetic zones of the separator insufficiently demarcated against each other.

This invention also aims to improve part-magnetic separators of a kind exemplified in the U.S. patent to Jobke No. 1,714,171.

It is an object of the present invention to provide a magnetic separator of improved efficiency, which is simple in construction, and in which the magnet system within the drum is so arranged that the drum periphery will be sharply and effectively subdivided into the respective magnetic and non-magnetic portions, that is with magnetic dispersion effects in the non-magnetic or neutral portion of the drum eliminated.

To attain this object, the invention provides a magnet system comprising a plurality of permanent magnet units or magnet members each having a plurality of radial magnet rods of equal polarity at the outer ends, arranged in alternation with similarly constructed complementary units or members consisting of ferro-magnetic or magnetizable material as distinct from permanent magnetic

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steel and combined with the permanent magnet units in a magnetic circuit. However, the poles of the complementary units are angularly staggered or offset relative to the permanent magnet poles, and preferably the extreme opposite permanent magnet rods define the magnetic portion against the non-magnetic portion of the drum periphery. These extreme outer magnet rods, because they are of equal magnetic polarity, eliminate magnetic dispersion effects thereby increasing the effectiveness of separation. The ferro-magnetic units assume the polarity opposite to that of the outer ends of the permanent magnet rods to constitute therewith the magnetic system, so that by this combination of permanent magnets and ferro-magnetic elements, there are effected substantial savings in the construction of the separator by the saving in permanent magnetic steel, practically without incurring any reduction in the effective magnetic force.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings in which:

Fig. 1 is a longitudinal sectional view of the improved magnetic separator showing the permanent magnet units alternating with the complementary ferro-magnetic units,

Fig. 2 is a cross-sectional view taken on line 2—2 of Fig. 1 showing the ferro-magnetic rods angularly staggered with respect to the permanent magnetic rods, and the extreme permanent magnetic rods defining the magnetic portion as against the non-magnetic portion of the drum.

In the embodiment herein shown to exemplify the invention, the part-magnetic separator has a magnet system so arranged as to make the drum half magnetic and half non-magnetic in effect.

The separator comprises a drum 1 of non-magnetic material which carries upon its outer surface magnetizable rods 2 extending parallel to the drum axis and equidistantly spaced from one another along the periphery of the drum for the purpose of providing magnetic flux lines such as set forth in my U.S. Patent No. 2,707,557.

In the magnet system of this embodiment, for example, three permanent magnet rods 5 are fastened upon and extend rigidly from a hub body 4 in a plane transversal of a mounting member or axle 3 upon which the hub body 4 is fixed. Each hub body 4 with its magnet rods thus constitutes a permanent magnet unit or member in which the magnet rods magnetized along their length extend towards the part of the drum periphery to be rendered magnetically effective for separation. In this embodiment, the magnetic unit or member has an uneven number of magnet rods with the outer end magnet rods shown to extend in diametrically opposite directions and presenting at their outer ends equal polarities here designated as the N-polarity.

The magnet system further comprises complementary magnet units consisting of ferro-magnetic or magnetizable material, in which a hub body 7 has radially extending conductor tongues or conductors 8 of ferro-magnetic material arranged in a plane transversal of the drum axis and angularly staggered with respect to the permanent magnet rods. Two conductors 8 are 45 degrees inclined against the two diametrically disposed permanent magnet rods as well as against the third intermediate permanent magnet rod. Thus, the conductor tongues 8 are angularly disposed so that they fit or bisect the angular spaces between the permanent magnet rods 5 and therefore bridge the distance between the same.

It will thus be understood that with the magnet rods 5 magnetically connected through poles of equal polarity

to the hub bodies, this polarity is conducted through the axles as well as through the mutually adjoining hub faces to the conductor tongues 8 so that the latter at their ends facing the drum constitute poles of the polarity opposite to that of the outer ends of the permanent magnet poles.

With the arrangement according to the invention, the magnetic flux lines are as indicated in dotted lines while magnetic dispersion in the non-magnetic drum space 6 is avoided, since the outer magnet rods 5 have equal polarity.

With the hub bodies 7 and their conductors 8 consisting of ferro-magnetic material, a substantial saving is effected in construction cost due to the savings in permanent magnetic steel, even though practically without reduction of the magnetic forces in the magnet system thus composed.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of magnetic separators differing from the types described above.

While the invention has been illustrated and described as embodied in a magnet system in which permanent magnet rods and conductor tongues or conductor rods extend radially from respective hub bodies, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A part-magnetic separator comprising, in combination, a non-magnetic drum; an axial mounting member for the drum and extending therethrough; a group of permanent magnet units carried by said axial member axially spaced from one another, each unit of the group having a hub portion with a plurality of permanent magnet rods extending radially therefrom toward said drum in a plane transversal of said axial member with the outer ends of the magnet rods representing poles of like polarity; and a group of complementary magnet units of ferro-magnetic material carried by said axial member and arranged to alternate in axial direction with the permanent magnet units so that the magnetic circuit is closed through the permanent magnet units and the complementary magnet units, each complementary magnet unit having a ferro-magnetic hub portion assuming from the adjoining permanent magnet units the polarity of the opposite sign, and a plurality of ferro-magnetic rods extending radially from said hub portion in a plane transversely of said axial member and angularly staggered with respect to the permanent magnet rods.

2. A part-magnetic separator comprising, in combination, a non-magnetic drum; an axial mounting member

for the drum and extending therethrough; a group of permanent magnet units carried by said axial member axially spaced from one another, each unit of the group having a hub portion with an uneven number of permanent magnet rods extending radially therefrom toward said drum in a plane transversal of said axial member with the outer ends of the magnet rods representing poles of like polarity, said magnet rods being so arranged with respect to each other and relative to the circumference of the drum that the ends of said magnet rods are angularly spaced along one peripheral portion of the inner surface of the drum so as to divide the drum into a magnetically effective peripheral portion and a complementary magnetically ineffective portion; and a group of complementary magnet units of ferro-magnetic material carried by said axial member and arranged to alternate in an axial direction with the permanent magnet units and that the magnetic circuit is closed through the permanent magnet units and through the complementary magnet units, each complementary magnet unit having a ferro-magnetic hub portion assuming from the adjoining permanent magnet units the polarity opposite to that of the outer ends of the magnet rods, and an even number of ferro-magnetic rods extending radially from said hub portion in a plane transversely of said axial member and angularly staggered with respect to the permanent magnet rods.

3. A part-magnetic separator comprising, in combination, a non-magnetic drum; an axial mounting member for the drum and extending therethrough; a group of permanent magnet units carried by said axial member axially spaced from one another, each unit having a plurality of permanent magnet rods extending radially from a magnetic hub portion toward said drum in a plane transversal of said axial member with the outer ends of the magnet rods representing poles of like polarities; and a group of complementary magnet units of ferro-magnetic material carried by said axial member and arranged to alternate in axial direction with the permanent magnet units with the magnetic circuit closed through the permanent magnet units and the complementary magnet units, each complementary magnet unit having a ferro-magnetic hub portion and a plurality of ferro-magnetic rods extending radially from said ferro-magnetic hub portion in a plane transversely of said axial member and angularly staggered with respect to the permanent magnet rods, so that the outer ends of said ferro-magnetic rods present polarities opposite to that of the outer ends of the permanent magnet rods, the number of ferro-magnetic rods in the complementary units differing by one from the number of permanent magnet rods in the permanent magnet units, the relative arrangement of the permanent magnet units and the complementary magnet units being such that the extreme rods defining the magnetically effective peripheral portion from the magnetically ineffective peripheral portion of the drum periphery are of like polarity.

References Cited in the file of this patent

UNITED STATES PATENTS

1,714,171 Jobke ----- May 21, 1929

FOREIGN PATENTS

461,816 Great Britain ----- Feb. 25, 1937