April 14, 1953 R. H. STEARNS 2,634,861

MAGNETIC SEPARATOR

Filed Jan. 19, 1949 3 Sheets-Sheet 1

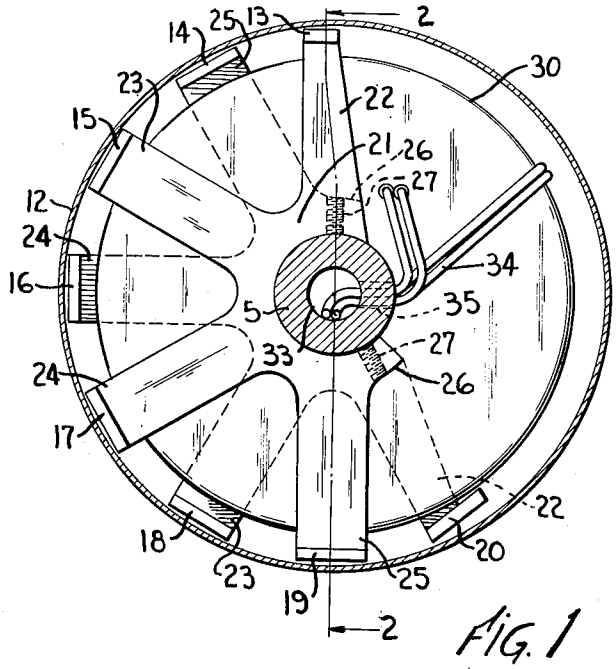


FIG. 1

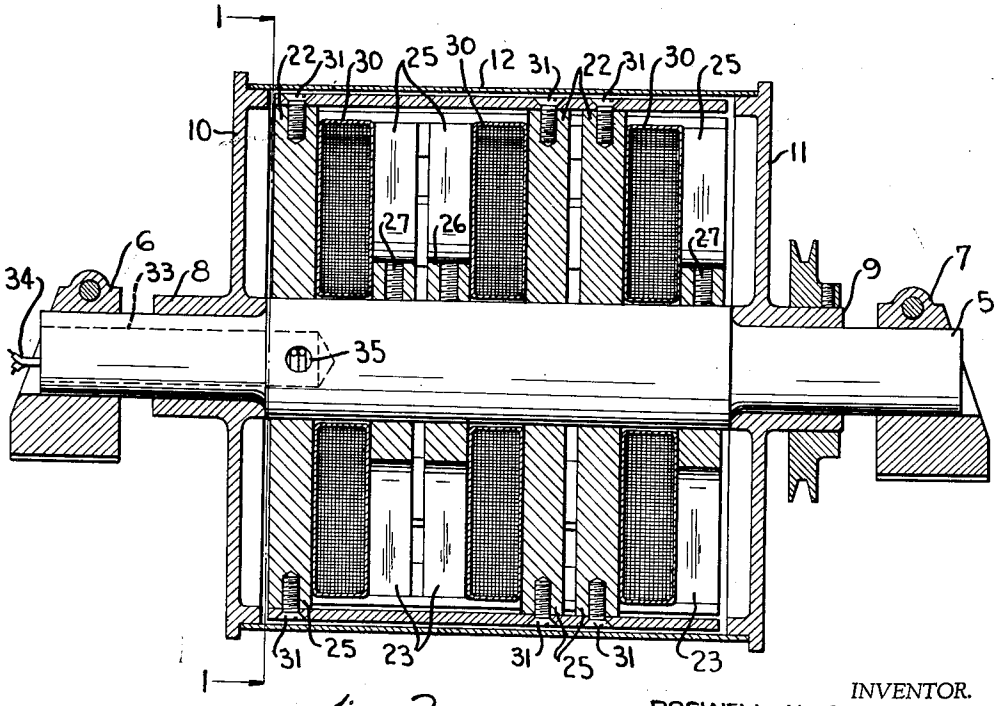


FIG. 2

INVENTOR.
ROSWELL H. STEARNS
BY
Wheeler, Wheeler & Wheeler
ATTORNEYS

April 14, 1953

R. H. STEARNS

2,634,861

MAGNETIC SEPARATOR

Filed Jan. 19, 1949

3 Sheets-Sheet 2

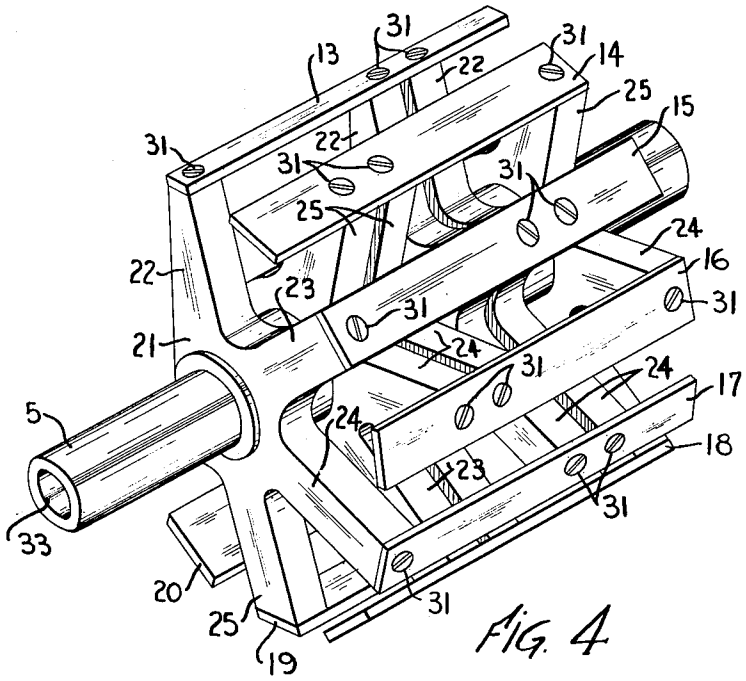


FIG. 4

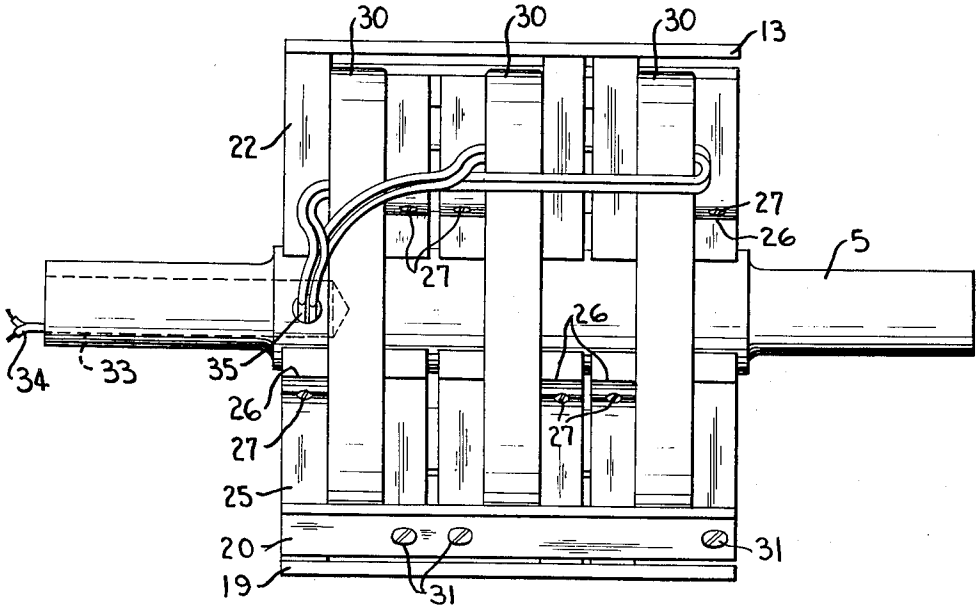


FIG. 3

INVENTOR.
ROSWELL H. STEARNS
BY
Wheeler, Wheeler & Wheeler
ATTORNEYS

April 14, 1953 R. H. STEARNS 2,634,861

MAGNETIC SEPARATOR

Filed Jan. 19, 1949 3 Sheets-Sheet 3

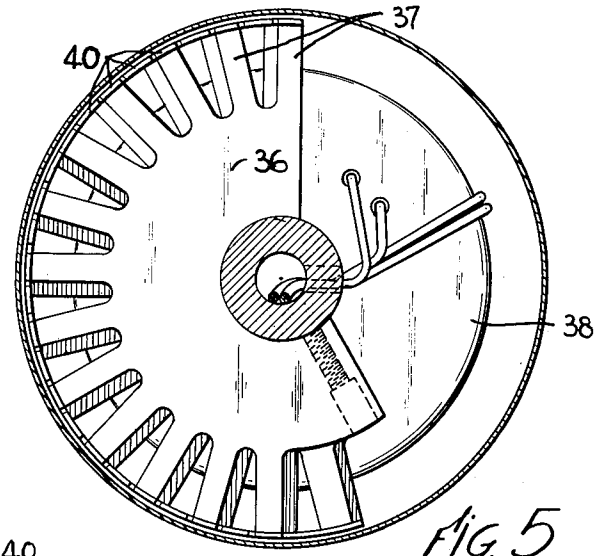


FIG. 5

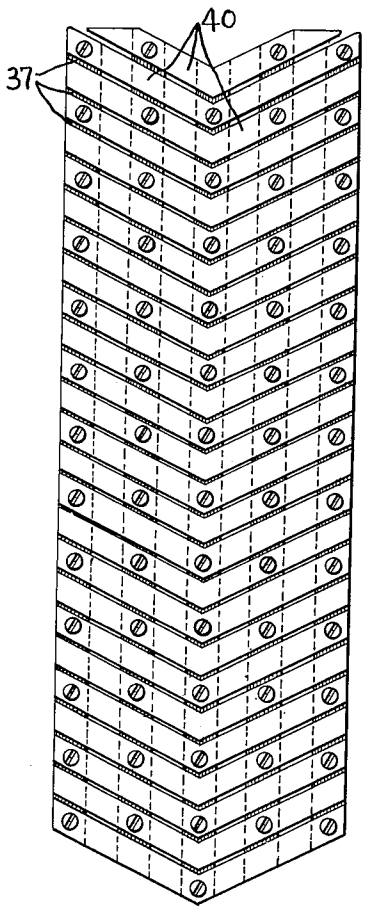


FIG. 6

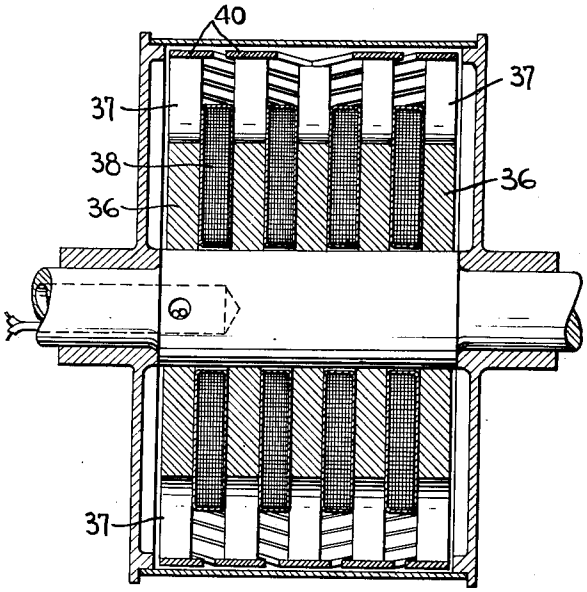


FIG. 7

INVENTOR.
ROSWELL H. STEARNS
BY
Wheeler, Wheeler & Wheeler
ATTORNEYS

Patented Apr. 14, 1953

2,634,861

UNITED STATES PATENT OFFICE

2,634,861

MAGNETIC SEPARATOR

Roswell H. Stearns, Milwaukee, Wis., assignor of one-half to Roswell N. Stearns, Milwaukee, Wis.

Application January 19, 1949, Serial No. 71,705

5 Claims. (Cl. 209—223)

1

This invention relates to a magnetic separator of the type having stationary magnet poles and a rotatable drum or pulley.

It is a primary object of the invention to provide a novel and simplified construction in which the number of coils required is greatly reduced, and yet magnets of unusual strength and depth of field are provided. In practice, I accomplish with three coils, results equal to, or superior to, the results which have heretofore required fifty-four coils.

Further objects of the invention and the means by which these results are achieved will appear more particularly from the following disclosure of the invention, reference being made to the accompanying drawings, in which:

Fig. 1 is a view taken through a magnetic separator embodying the invention, the view being taken in the plane indicated at 1—1 in Fig. 2.

Fig. 2 is a view in longitudinal section through a magnetic separator embodying the invention, the view being taken in the plane indicated at 2—2 in Fig. 1.

Fig. 3 is a view in rear elevation of the magnets of the separator shown in Fig. 1 and Fig. 2.

Fig. 4 is a detail view in perspective showing the pole arrangement as it appears without the coils or drum.

Fig. 5 is a view in end elevation of a modified embodiment of the invention.

Fig. 6 is a developed view showing, as if in plan, the periphery of the pole organization of the device of Fig. 5, the external drum or pulley being omitted.

Fig. 7 is a view in axial section through the device of Figs. 5 and 6.

As is usual in separators of this type, the device is assembled upon a shaft 5 which is stationary, being clamped in supports 6 and 7. Rotatable upon the shaft are the hubs 8 and 9 at the ends 10 and 11 of the drum 12. The material requiring separation may either be fed directly over the periphery of the drum, or carried to the drum on a belt which passes about the drum as a pulley. In all of these respects, the structure is conventional.

Supported within the drum are pole pieces about which the drum rotates. These may take the form of bars which extend in a direction which is, in general, axially of the drum, the bars alternating as to polarity. For example, referring to Figs. 1 and 4, the bars 13, 15, 17 and 19 may be north poles, and the intervening bars 14, 16, 18 and 20 may be south poles. In the past, each of these bars has been energized by coils

2

having their axes disposed radially. The present device makes use of larger coils of so-called "pancake" form which extend axially of the drum.

I may use any desired number of magnetic assemblies upon the stationary shaft 5. For purposes of illustration, I have shown, in Figs. 1 to 4, three such assemblies, each of which, in this embodiment, comprises two polar units having spoke-like arms and an intervening pancake coil. The polar units may be identical. Each comprises a hub 21 from which arms 22, 23, 24 and 25 extend outwardly (preferably radially). The hub need not be a complete ring, but desirably extends circumferentially about the shaft 5 for a sufficient arcuate distance to enable it to be anchored securely thereon as shown in Figs. 1 and 3. Desirably, the hub projects sufficiently at 26 beyond the last of the polar arms 25 mounted thereon to receive a set screw 27 which engages the shaft. In each magnetic assembly, the polar members are turned end for end, this being a matter of convenience, as a means of staggering or offsetting the arms of one angularly midway between the arms of the other as clearly appears in Figs. 1 and 4. The staggering or offsetting of the arms of the polar members is merely a convenient means, in this particular embodiment, of providing for the use of rectilinear polar bars, while assuring that each such bar will engage only those polar arms which are of like polarity in the several assemblies.

Between each pair of polar members making up a given magnet assembly is disposed one of the pancake coils 30. Since the coil is disposed axially, the entire magnetic polar member at one side thereof will be of north polarity, and the entire magnetic member at the other side thereof will be of south polarity. Preferably, the consecutive magnetic assemblies (if more than one is used) are so mounted on the stationary shaft 5 that members of like polarity are grouped or placed together in mutually adjacent relation. Thus, referring to Fig. 2, if the first polar member is so energized as to have north polarity, the second and third polar members will be of south polarity, the fourth and fifth of north polarity, and the last, of south polarity. The ends of the polar arms are tapped to receive the screws 31 by which the respective polar bars are connected to the polar arms of corresponding polarity. Thus, every pole piece or bar has one arm energizing it and supporting it for every magnet assembly used in the device. The pole piece or bar 13 overhangs beyond its last support at the far end of the assembly as viewed in Fig. 4, whereas the south

pole piece 14 overhangs at the near end of the assembly as shown in that view. Successive pole pieces overhang alternately at opposite ends of the device, but each has as many energized supporting arms as there are magnetic assemblies.

Since even a large coil such as the pancake coil shown at 30 may be wound with very much less effort and expense than is required for the winding of eighteen smaller coils, it follows that the cost of making a separator of this construction is very materially less than the cost of making a separator of the conventional type. Yet, the present device gives an exceptionally deep and powerful field. As the material to be separated is carried on the drum about the stationary pole pieces 13, 14, 15, 16, 17, 18, 19 and 20, the magnetic material is caused to shift its position each time it passes from the immediate proximity of one pole piece into proximity to a pole piece of different polarity. The resulting movement frees the non-magnetic material from the magnetic material and, since the magnets of the present device are exceptionally powerful, the resulting movement is exceptionally vigorous, and a high degree of separation is achieved.

One end of shaft 5 may be bored at 33 to receive the wiring 34 which may emerge through the lateral hole 35 to be connected to the several coils 30 for the energization thereof.

In the embodiment shown in Figs. 5 to 7, each magnetic assembly comprises a single polar unit and its associated coil. Each polar unit comprises a hub portion 36 from which project in substantially radial direction the arms 37.

Adjacent each polar unit is its coil 38. The coils, or the connections thereto (which amounts to the same thing) are inverted as between consecutive coils so that the alternate polar units will be magnetized to have opposite polarity. Thus, referring to Figs. 6 and 7, all of the polar arms 37 in the first polar unit may be energized to constitute north poles, while all the arms of the second polar unit will be energized to constitute south poles. The radial polar arms of the third unit will be north, the fourth south, and the fifth north again.

Since the polar arms of the several units are all aligned axially, as clearly indicated in Fig. 6, and since they alternate in polarity, it is obvious that if the polar pieces were rectilinear and extended axially as shown in Fig. 4, they would short-circuit the magnetic flux. It is, however, possible to so locate the pole pieces 40 that they connect only polar arms of like polarity, this being done by extending them helically about the shaft. To the extent that they are carried peripherally, as well as axially, they will tend to advance the magnetic material axially of the shaft. In some instances, this is an aid to separation. By making the pole pieces 40 in such manner that their angularity is reversed, and the pole pieces have the general form of a chevron in developed plan, as clearly shown in Fig. 6, I am able to tend to concentrate the magnetic material at the center of the drum, if the relative direction of movement is downward as viewed in Fig. 6, or to disperse the magnetic material to the two sides of the drum if the relative direction of drum movement is upward, as viewed in Fig. 6. Since the direction of drum rotation will ordinarily be counterclockwise as viewed in Fig. 5, the direction of relative movement can be changed by reversing the entire magnetic assembly, end for end, within the drum.

The mounting of the respective hub portions and magnets upon the shaft may be accomplished in any desired way, the illustrated mounting being substantially identical with that previously described.

I claim:

1. A magnetic separator comprising a rotary drum, a fixed shaft upon which the drum is rotatably mounted, a plurality of magnetic assemblies assembled in fixed axially spaced relation upon the shaft, each such assembly comprising a magnetic member having a hub fixed on the shaft and arms projecting outwardly therefrom, a second magnetic member having a hub fixed on the shaft and arms projecting outwardly therefrom, and an intervening annular coil encircling the shaft and fixed thereto and energizing said members with opposite polarity, the polarity of the coils of successive magnetic assemblies on said shaft being reversed whereby the adjacent magnetic members of consecutive assemblies are of like polarity, the arms of the respective members being staggered, whereby a given arm of one member is intermediate arms of opposite polarity of the other member of said assembly; pole pieces extending longitudinally of the shaft and angularly spaced in peripheral series about the shaft, the respective pole pieces being connected with arms of like polarity in the several assemblies for mounting and energization thereby, each pole piece being of uniform magnetic strength throughout its length.

2. A magnetic separator comprising the combination with a rotatable separating drum and a relatively fixed shaft, of a series of polar bars of alternate polarity immediately within the periphery of the drum and having a general extent from one end thereof toward the other end of the drum, said bars being arranged in a series in which such bars are spaced peripherally of the drum throughout a portion of the inner periphery thereof, another portion being free of such bars, hubs fixed with said shaft and disposed in axial series along said shaft within the drum and each hub being provided with a plurality of separate spokelike polar elements extending in a plane toward the drum periphery and each connected with one of said bars, annular coils encircling the shaft and each coil having an end adjacent the polar elements of a particular hub for rendering such polar elements magnetic, said coils having windings and electrical connections rendering them alternate in polarity, each polar bar extending between the polar elements of unlike polarity and being solely connected with and mounted upon polar elements of like polarity and being of substantially uniform magnetic strength throughout its extent.

3. The device of claim 2 in which the said polar bars of alternate polarity are substantially rectilinear, the respective spokelike polar elements supporting each bar being angularly offset from spokelike polar elements supporting adjacent bars of differing polarity.

4. The device of claim 2 in which respective polar bars are chevron-shaped in projected plan having apices aligned upon a peripheral line drawn about the drum intermediate its ends.

5. A magnetic separator comprising the combination with a rotatable separating drum and a relatively fixed shaft upon which such drum is rotatably supported, of a series of polar bars of alternate polarity immediately within the periphery of the drum and having a general extent from one end thereof toward the other, said

bars being arranged in a series in which such bars are spaced peripherally of the drum throughout a portion of the inner periphery thereof, another portion being free of such bars, hubs in axial series along said shaft within the drum and respectively provided with spokelike polar elements projecting toward the drum periphery and connected with said bars, annular coils encircling the shaft and each having an end adjacent the polar elements of a particular hub for rendering such polar elements magnetic, said coils having windings and electrical connections rendering them alternate in polarity, each polar bar being connected with polar elements of like polarity and being of substantially uniform magnetic strength throughout its extent, said polar bars of alternate polarity being substantially rectilinear, the respective spokelike polar elements supporting each bar being angularly offset from spokelike polar elements supporting adjacent bars of differing polarity, said hubs and polar

elements being disposed adjacent both ends of each coil, there being paired spaced polar elements of like polarity intervening between consecutive coils and connected to the same polar bar.

ROSWELL H. STEARNS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
432,823	Finney	July 22, 1890
443,044	Finney	Dec. 16, 1890
455,985	Fiske	July 14, 1891
1,324,529	Ullrich	Dec. 9, 1919
1,714,171	Jobke	May 21, 1929

FOREIGN PATENTS

Number	Country	Date
35,969	Denmark	Apr. 28, 1926