United States Patent [19]

Reading

[11] **3,849,301**

[45] **Nov. 19, 1974**

[54] **MAGNETIC SEPARATOR**

[75] Inventor: **Hugh Thomas Reading,** Goonellabah, New South Wales, Australia

[73] Assignee: **Readings of Lismore Pty., Limited,** Lismore, New South Wales, Australia

[22] Filed: **Dec. 7, 1972**

[21] Appl. No.: **313,182**

[30] **Foreign Application Priority Data**

Dec. 15, 1971 Australia 7394/71

[52] **U.S. Cl.** **209/214,** 209/221, 209/232

[51] **Int. Cl.** **B03c 1/00,** B03c 1/10

[58] **Field of Search** 209/219, 221, 222, 223, 209/220, 227, 232, 226, 214; 210/222, 223

[56] **References Cited**

UNITED STATES PATENTS

345,383	7/1886	Kesslen	209/219 X
823,492	6/1906	Dunham	209/219
901,368	10/1908	Payne	209/219
1,462,111	7/1923	Jobke	209/222
2,074,085	3/1937	Frantz	209/222 X
3,326,374	6/1967	Jones	209/232 X
3,375,925	4/1968	Carpenter	209/223 R

FOREIGN PATENTS OR APPLICATIONS

294,321	9/1969	Australia	209/223 R
401,301	11/1933	Great Britain	209/219
777,011	6/1957	Great Britain	210/222

Primary Examiner—Robert Halper

[57] **ABSTRACT**

A wet magnetic separator having a rotor formed on its periphery with an annular through passage which is defined by annular walls and which is divided into channels by radially extending spacers of a magnetisable material, the rotor being surrounded by a number of pole pieces (successive ones of which being of opposite polarity) and the rotor being constructed in such manner that a magnetic field of maximum intensity is induced in the rotor spacers which are at any one time located intermediate successive pole pieces.

10 Claims, 2 Drawing Figures

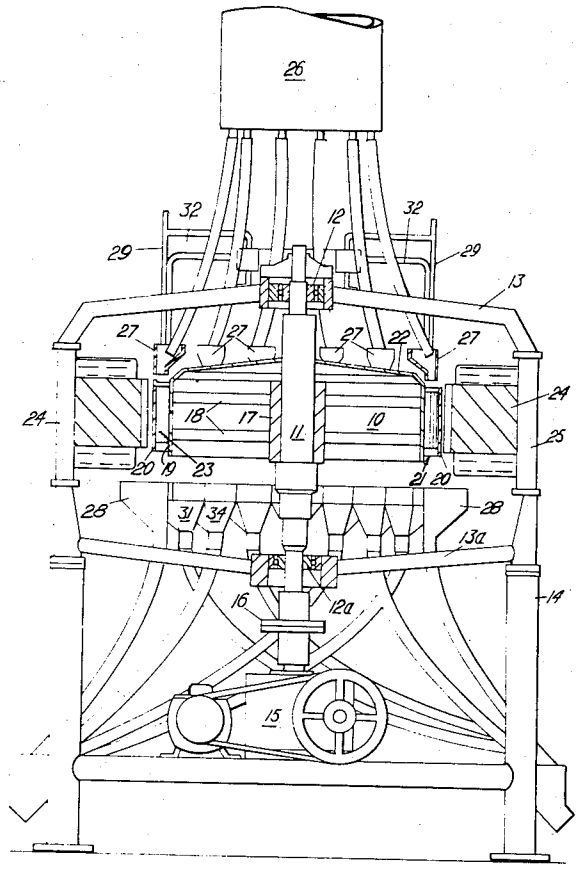


Fig. 1.

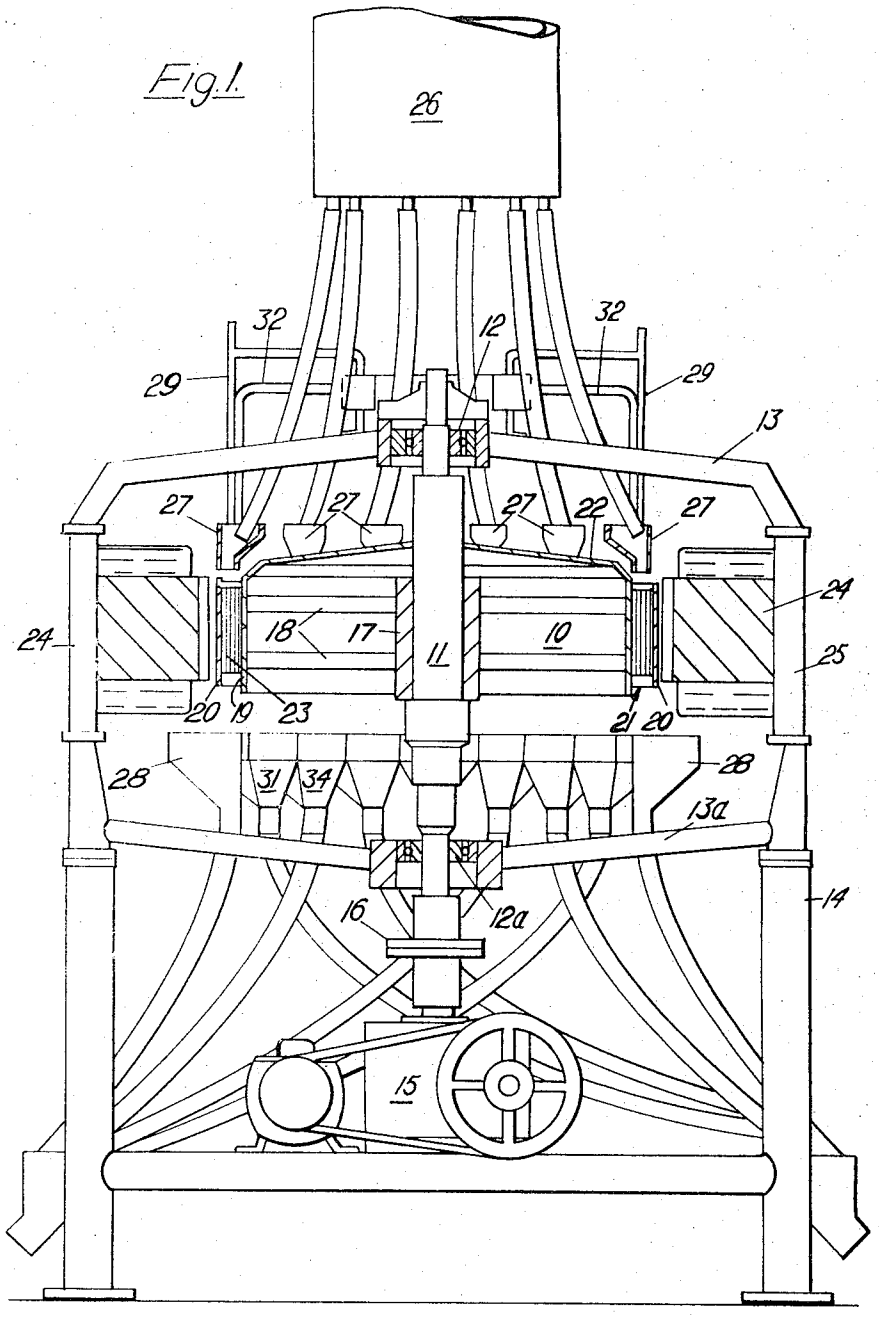
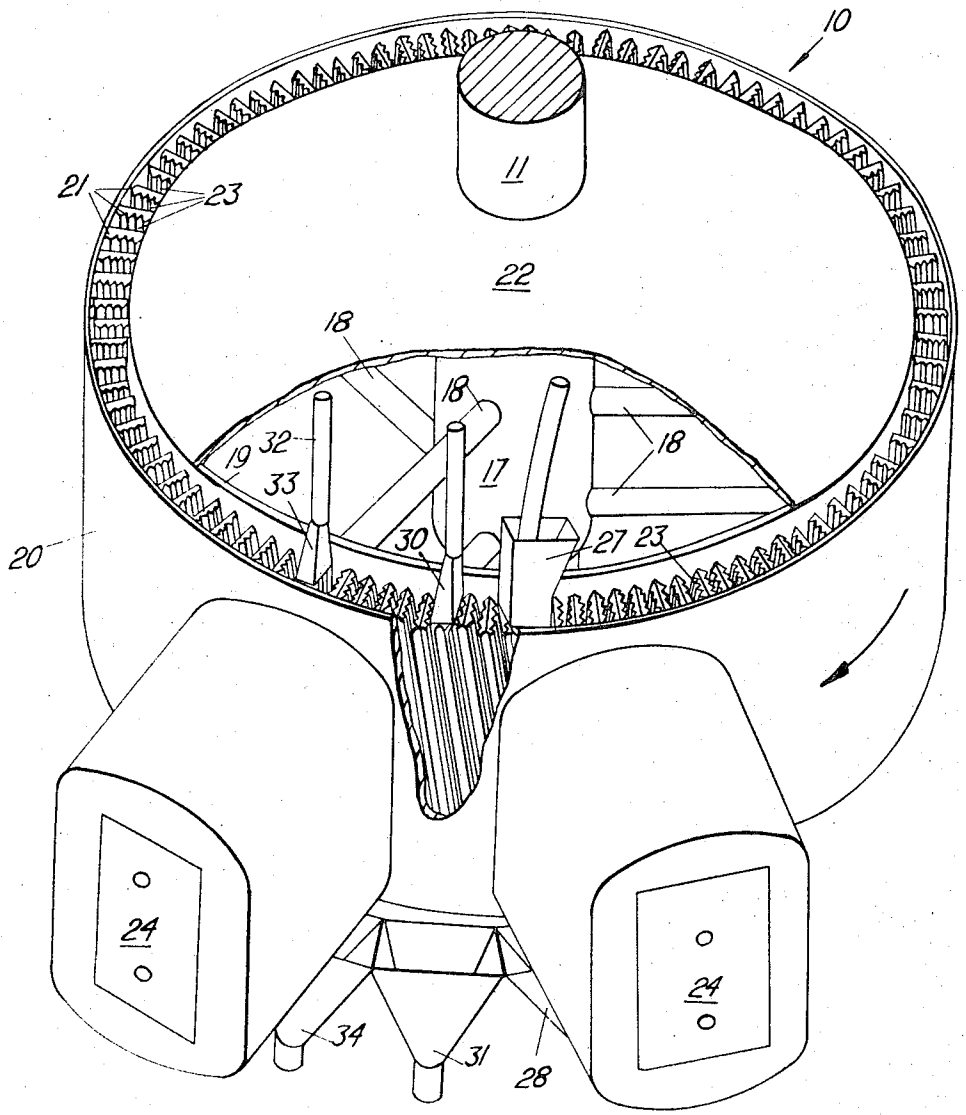

26
32
12
32
29
29
13
27
27
27
22
27
24
24
18
17
11
10
25
20
19
23
21
20
28
28
31
34
13a
14
16
12a
15

Fig. 2



MAGNETIC SEPARATOR

This invention relates to a separator for employment in magnetic separation of magnetic particles from a fluid suspension, and in particular to a separator of the type having a rotor surrounded by a number of fixed magnetic poles, successive ones of which are of opposite polarity.

The separator in accordance with the present invention (as hereinafter defined) may be considered in the context of the somewhat similar separator subject of Australian Pat. No. 294,321. The separator subject of that Patent incorporates a rotor, the periphery of which is formed with a series of surface channels or grooves, and it is surrounded by a number of magnetic poles, the successive ones of which are of opposite polarity. The arrangement of the poles, with respect to the rotor, is such that an area of maximum magnetic concentration occurs at the surface of the rotor which at any one time is adjacent a pole and an area of minimum magnetic field strength occurs at the rotor area which, at any one time, is located intermediate successive poles. This arrangement permits collection from below the rotor of non-magnetic particles in approximate alignment with the point of feed to the rotor and collection of magnetic particles by washing at a point intermediate successive poles.

The separator subject of the above-referenced Patent, and as above described in brief, has been found ideally suited for the separation of a composite material from which non-magnetic particles are to be collected as the component of interest. However, it has been found that the separator described in the above Patent does not have, under certain conditions, sufficient capacity for the separation of a composite from which magnetic particles are to be collected and from which non-magnetics are to be discharged as unwanted or waste components, particularly where the magnetic particles do themselves constitute the largest proportion of the total composite. The present invention seeks to provide a separator which may be employed efficiently for this purpose.

Thus, there is provided in accordance with the present invention a separator for employment in the magnetic separation of magnetic particles from a fluid suspension, and which comprises:

a. a rotor having at least one annular through passage constituting or formed on its periphery, the through passage being disposed about the axis of rotation of the rotor;

b. a number of spacers of a magnetically permeable material extending between walls of the or each passage, successive spacers, together with the passage walls, defining through channels into which magnetic particles in a fluid suspension may be fed to pass in a direction substantially parallel to the axis of the rotor;

c. a number of magnetic pole pieces surrounding the rotor and having their magnetic axes disposed radially with respect to the rotor, successive ones of the pole pieces being of opposite polarity and the relationship of the pole pieces to the rotor being such that a magnetic field of maximum intensity is induced in the rotor spacers which are at any one time located intermediate successive ones of the pole pieces;

d. means for feeding a composite containing magnetic particles in a fluid suspension into said channels adjacent successive ones of the pole pieces;

e. means also adjacent successive ones of the pole pieces for washing magnetic particles from within the channels;

f. means intermediate successive pole pieces for delivering washing water to successive channels; and

g. separate means for collection of magnetic and non-magnetic particles which are passed or washed through the channels.

Preferably, the spacers are formed on opposite side faces thereof, with corrugations and, also as a preferable feature, the successive spacers, in extending between upper and lower ends of the rotor, incline (as a helix) in the direction of rotation of the rotor.

The walls of the through passage or passages referred to above are preferably formed from bands of stainless steel having essentially non-magnetic characterisitics, and the spacers above stated would be formed from a high permeability stainless steel. An inner one of the through passage walls is interconnected with the rotor hub by a number of radially extending spokes, which are also, preferably, formed of a non-magnetic stainless steel.

The rotor is preferably cylindrical in form but it might be tapered as a truncated cone between the upper and lower ends thereof. In such a case the material passed through the channels defined by the spacers and the rotor walls would not (or need not) travel in a direction which is strictly parallel to the rotor axis, and the above statement that the fluid is fed to pass in a direction "substantially" parallel with the axis of the rotor is to be read in this context.

The invention will be more fully understood from the following description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an elevation view of a magnetic separator with a portion thereof shown in section, and

FIG. 2 is a perspective view of a rotor assembly of the separator, the relationship of the rotor assembly to a number of associated pole pieces being also illustrated.

As shown, the separator comprises a rotor **10** which is keyed to a rotor shaft **11.** The shaft **11** is journalled for rotation in bearings **12** and **12***a* which are, in turn, carried by support arms **13** and **13***a* of a support frame **14.** Drive is transmitted to the rotor shaft from a motor-gearbox arrangement **15** via a coupling **16.**

The rotor **10** comprises a hub **17,** a number of non-magnetic stainless-steel spokes **18** and, constituting the periphery of the rotor, two non-magnetic stainless-steel bands **19** and **20.** The bands **19** and **20** are spaced-apart in a radial direction to define an intermediate through passage **21** which extends around the periphery of the rotor.

A splash guard **22** is located above the rotor.

A series of corrugated form spacers of a magnetically permeable material **23** extend in a radial direction between the two passage forming walls **19** and **20,** successive ones of the spacers, together with the passage walls defining through-channels for a material slurry or composite fed thereto.

The spacers **23** extend for approximately the height of the rotor, and they are inclined slightly in the direc-

tion of rotation of the rotor so as to provide a simulated helical path for material conveyed through the channels of the rotor.

A number of electrically energised magnetic pole pieces **24** which are yoked by a mild-steel band **25** surround the rotor (although only two such pole pieces are shown in FIG. **2**) and successive ones of the pole pieces are energised so as to be of opposite polarity. With this construction a maximum flux density or field strength will occur in the spacers **23** which are at any one time positioned intermediate successive pole pieces, and a minimum flux density will occur in the same spacers when they are positioned in direct alignment with the axes of the successive pole pieces.

With the apparatus described thus far, a slurry form composite material from which magnetic particles are to be separated is conveyed from a storage receiver **26** into the rotor channels at successive points around the periphery of the rotor adjacent the trailing edge of each of the pole pieces in the direction of feed of the rotor. The composite material is delivered by way of fixed delivery nozzles **27.** In feeding the composite material at this point, magnetic and partially magnetic particles will be held captive upon the surface of the spacers **23,** and non-magnetic particles will flow straight through the channels, to be collected in a "non-magnetics" launder **28** located beneath the rotor.

A wash water is supplied to the channels via delivery lines **29** and nozzles **30** at a point intermediate successive pole pieces for washing magnetic particles (or middlings) of low concentration into launders **31.** The product which flows into the launders **31** may be either treated as waste or be recycled through the machine.

Then, at a point in alignment with the magnetic axes of the successive pole pieces, a further wash water supply is delivered to the channels via delivery lines **32** and nozzles **33** in order to wash magnetic particles into launders **34.**

I claim:

1. A magnetic separator-comprising:

a. a magnetically impermeable rotor mounted on a vertically oriented shaft and having at least one annular through passage constituting or formed on its periphery and defined by spaced-apart walls, the walls being formed from a material having non-magnetic characteristics, and the or each through passage being disposed about the axis of rotation of the rotor,

b. a number of spacers of a magnetically permeable material extending in a radial direction between the walls of the or each passage, successive spacers, together with the passage walls, defining through channels into which magnetic particles in a fluid suspension may be fed to pass in a direction substantially parallel to the axis of the rotor,

c. a number of magnetic pole pieces surrounding the rotor and having their magnetic axes disposed radially with respect to the rotor, successive ones of the pole pieces being of opposite polarity whereby a magnetic field of maximum intensity is induced in the rotor spacers intermediate successive ones of the pole pieces;

d. means for feeding a composite containing magnetic particles in a fluid suspension into said channels adjacent successive ones of the pole pieces;

e. means also adjacent successive ones of the pole pieces for delivering a washing fluid for washing magnetic particles from within the channels;

f. means intermediate successive pole pieces for delivering a washing fluid to successive said channels, for washing non-magnetic particles from within the channels, and

g. separate means for collection of magnetic and non-magnetic particles which are passed or washing through the channels.

2. A magnetic separator as claimed in claim **1** wherein the rotor is formed on its periphery with a single said through passage and wherein the spacers extend radially between the walls thereof.

3. A magnetic separator as claimed in claim **2** wherein the spacers are formed on their opposite (channel defining) faces with corrugations which extend in a direction between opposite ends of the rotor.

4. A magnetic separator as claimed in claim **2** wherein the spacers have a length approximately equal to the axial length of the rotor and the spacers are inclined in the direction of rotation of the rotor.

5. A magnetic separator as claimed in claim **2** wherein the through passage is concentric and parallel with the axis of the rotor.

6. A magnetic separator as claimed in claim **2** wherein the passage defining walls of the rotor are constituted by annular bands of a stainless steel having non-magnetic characteristics.

7. A magnetic separator as claimed in claim **2** wherein the means for feeding the composite into the rotor channels are located outside one end of the rotor and adjacent the trailing edge of the respective pole pieces in the direction of rotation of the rotor.

8. A magnetic separator as claimed in claim **2** wherein the means for delivering a washing fluid for washing magnetic particles from within the channels are located outside one end of the rotor and are aligned with the axis of the respective pole pieces.

9. A process for effecting separation of magnetic particles from a composite fluid suspension material comprising the steps of: passing the composite material having magnetic and nonmagnetic ingredients therein through an annular passage of a rotor rotating about a vertical axis having magnetically impermeable spaced-apart walls defining such annular passage, collecting the magnetic particles on the surfaces of a number of spaced magnetically permeable spacers which are disposed at regular circumferential intervals within said passage to define channels receiving a flow of such fluid suspension as it is directed substantially parallel to the axis of the rotor, imposing a magnetic force through a series of circumferentially spaced magnetic pole pieces surrounding said rotor to develop a magnetic field of maximum intensity in the rotor spacers intermediate successive ones of pole pieces, washing in the region of said successive pole pieces the magnetic particles from within the channels and which are adhered to said spacers, and separately washing in the region intermediate said successive pole pieces and collecting the non-magnetic particles from within said channel.

10. The process in accordance with claim **9** including the step of separately collecting the magnetic and non-magnetic particles which are washed through the channels.

* * * * *