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(54) Magnetic separation.

(57) A magnetic separator includes a carrier sheet (21) over which material to be separated magnetically into two or more fractions passes and, behind the sheet, an arrangement for moving successive pairs of parallel bar magnets along the sheet. The pairs are separated by gaps so that there are gaps between magnetic flux lobes to which the material to be separated is subjected.

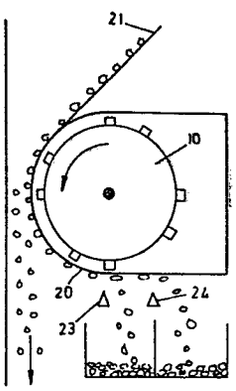

FIG _ 2

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MAGNETIC SEPARATION

This invention relates to magnetic separation and particularly to the separation of ferromagnetic particles from a mixture of particles containing them.

A magnetic separator has already been proposed in which a roll carrying permanent magnets rotates in an envelope concentric with the roll. The magnetic circuit is so arranged that as the roll rotates it carries with it zones of high magnetic gradients - see the complete specification of South African Patent No: 80/3785. This prior proposal has not proved to be very successful in practice.

An object of the invention is to provide a separation system which, it is expected, will be more successful.

In accordance with the invention, a method of transporting ferromagnetic particles on a non-magnetic sheet against the action of gravity and inertia comprises the step of moving successive pairs of parallel bar magnets with opposed polarities facing the sheet behind the sheet, so that successive magnetic field lobes of substantially the same volume pass the same parallel lines on the sheet, with gaps between lobes composed of zones without any significant field gradients or field gradients substantially smaller than the gradients in the lobes.

The surface may be provided by a non-magnetic envelope and the bar magnets may be mounted on the surface of a drum parallel to the envelope. Preferably pairs of bar magnets are mounted to the drum surface on soft iron yokes.

In the preferred form of the invention each pair of bar magnets is flanked by pairs in which the polarities are switched. Also it is preferred that the spacing between pairs be at least equal to the spacing between magnets in a pair and preferably about 2.5 times that spacing.

The invention is illustrated further with reference to specific embodiments shown by way of example in the accompanying drawings in which:

Figure 1 is a diagrammatic end view of a separating roll,

Figure 2 is a view showing one application of the roll, and

Figure 3 is a view showing another application.

The roll shown in Figure 1 comprises a mild steel drum 10 mounted on a shaft 11 which is journalled for rotation and connected to suitable motion transmission means to cause the drum 10 to rotate.

On the surface of the drum 10 there are mounted bar magnets extending parallel to the axis of the drum 10. The bar magnets are samarium-cobalt magnets, which are preferred due to their low mass. Barium ferrite magnets can also be used. The bar magnets have been mounted in pairs with the members of a pair marked 13 and 14. The magnets 13 are so magnetised that their radially outermost faces are North poles while the magnets 14 have South poles as their radially outermost faces. The angle between pairs of magnets 13 and 14 at the centre of the drum 10 is 30° while the angle between adjacent pairs of

magnets 14 or 13 is 60°.

A typical application of the roll of Figure 1 is shown in Figure 2. In this case a dry powdery mixture containing ferromagnet particles is treated for the removal or recovery of the ferromagnetic particles. The drum 10 is surrounded by an envelope 20 of non-magnetic material, e.g. fabricated from a sheet of stainless steel. The mixture to be treated is fed on to a plate 21 so that the mixture slides past the envelope 20. Non-magnetics fall under the action of gravity while ferromagnetic particles are transported along the surface of the envelope 20. Weakly ferromagnetic particles fall between splitters 23 and 24 while the strongly ferromagnetic particles fall beyond the splitter 24.

What is surprising about the example described with reference to Figure 2 is that when a drum with bar magnets spaced equidistantly around its periphery with North and South poles alternating, ferromagnetics were attracted to the envelope, but there was no proper transport and particles did not readily fall off towards the splitters, but bunched above the splitter 24. The spacing provided in Figure 1 seems to make all the difference.

It also seems important that the magnets flanking a space between pairs of magnets should have the same polarity to ensure most effective transport of ferromagnetics.

While the invention has particular application for use on dry materials, it can also be applied to slurries, e.g. in the manner shown in Figure 3. Here a slurry is pumped in at 31 to overflow at 32. Ferromagnetic particles are attracted towards the envelope 30 and pass over under a spray 33 which transports them further.

CLAIMS

1. A method of transporting ferromagnetic particles on a non-magnetic sheet against the action of gravity and inertia characterised by comprising the step of moving successive pairs of parallel bar magnets, with opposed polarities facing the sheet, behind the sheet, so that successive magnetic field lobes of substantially the same volume pass the same parallel lines on the sheet, with gaps between the lobes composed of zones without any significant field gradients or field gradients substantially smaller than the gradients in the lobes.

2. A carrier surface for a magnetic separator on which surface a series of pairs of bar magnets are mounted parallel to one another and transverse to the direction of movement of the carrier surface, characterised in that the bars of a pair have opposed polarities on their top faces relatively to the carrier surface and the arrangement is such that the field between members of a pair is substantially larger than the field gradients between neighbouring members of different pairs.

3. A carrier surface according to claim 2 characterised in that the neighbouring members have top faces of the same polarity.

4. A carrier surface according to claim 2 or 3 characterised in that the spacing between members of a pair is closer than the spacing between neighbouring members of different pairs.

5. A carrier surface according to claim 4 characterised in that the latter spacing is about

2.5 times the former spacing.

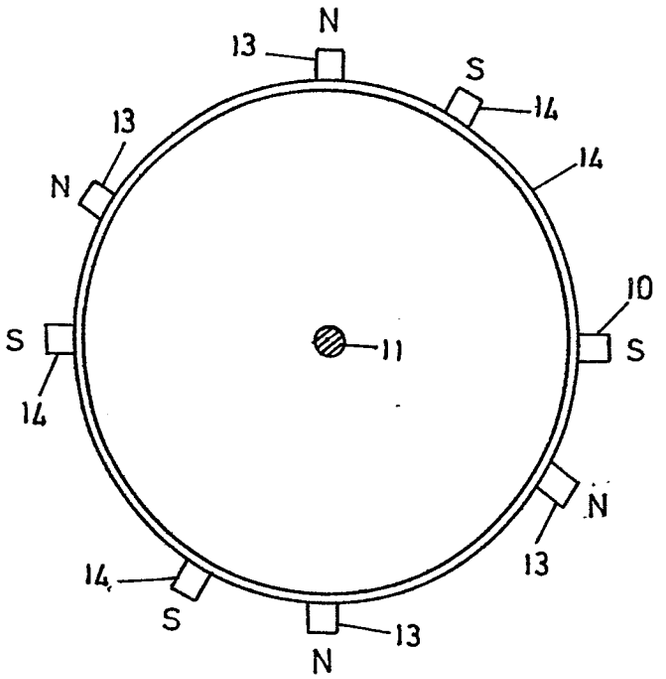
6. A magnetic separator characterised by including a surface as claimed in any one of claims 2 to 5, a non-magnetic surface to one side of which and relatively to which the carrier surface moves, means to feed material to be separated on to the non-magnetic surface and means acting on the material tending to cause particles in the material to move away from the carrier surface.

7. A separator according to claim 6 in which the carrier surface is a drum and the non-magnetic surface is an envelope around at least part of the drum.

8. A separator according to claim 6 or 7 in which the material tends to fall from the carrier surface under gravity.

9. A separator according to claim 6 or 7 in which the material is carried away from the carrier surface by means of a fluid.

FIG_1



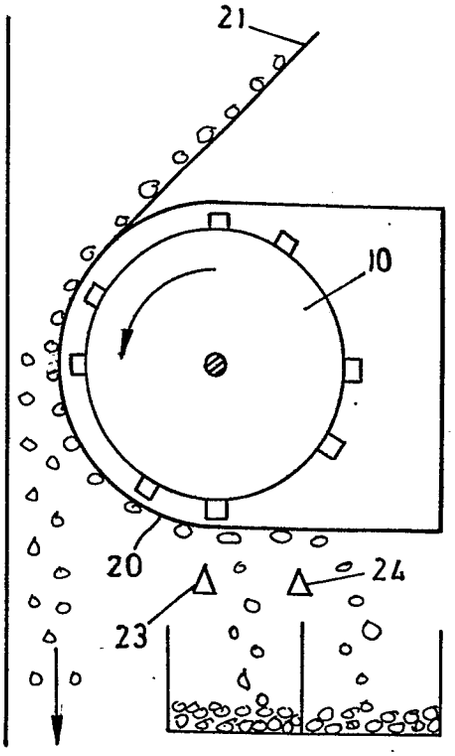


FIG_2

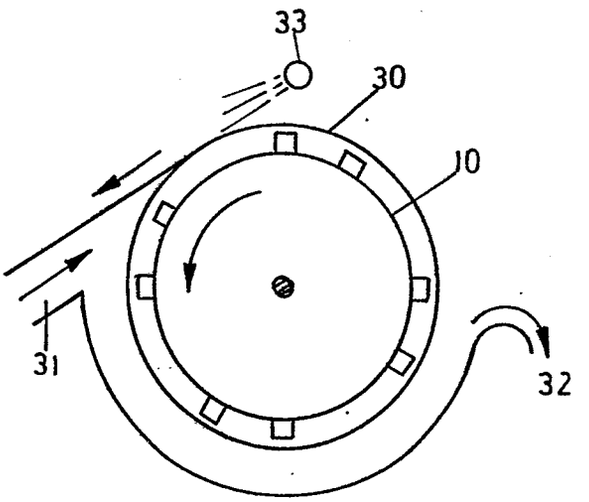


FIG_3