United States Patent [19]

Hodges

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[45] **Dec. 11, 1973**

[54] **MAGNETIC POWER HANDLING ARRANGEMENT**

[75] Inventor: **Robert James Hodges,** Chestnut, England

[73] Assignee: **International Standard Electric Corporation,** New York, N.Y.

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[21] Appl. No.: **146,947**

[30] **Foreign Application Priority Data**

June 23, 1970 Great Britain 30,325/70

[52] **U.S. Cl.** **118/637,** 117/17.5, 355/3

[51] **Int. Cl.** **G03g 13/00**

[58] **Field of Search** 355/3; 117/17.5; 118/623, 637

[56] **References Cited**

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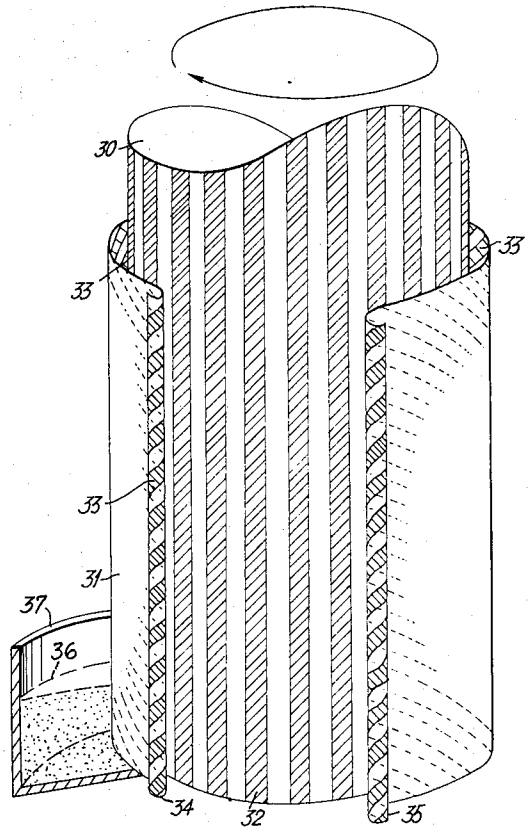
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Primary Examiner—Mervin Stein
Assistant Examiner—Leo Millstein
Attorney—C. Cornell Remsen, Jr. et al.

[57] **ABSTRACT**

A powder transport and applicator arrangement comprising a vertically arranged roller surrounded by a three-fourth cylindrical shield having a vertically running gap, with the lower ends of both the roller and the shield dipping into a powder bed containing magnetic powder. The roller possesses axially arranged magnetic strips, and the shield on its inner surface helical ones. Rotation of the roller causes magnetic powder from the powder bed to be drawn up the roller. The resultant even coating of powder on the roller is presented via the gap in the shield to a recording surface to develop a magnetic image recorded thereon.

8 Claims, 3 Drawing Figures



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SHEET 1 OF 3

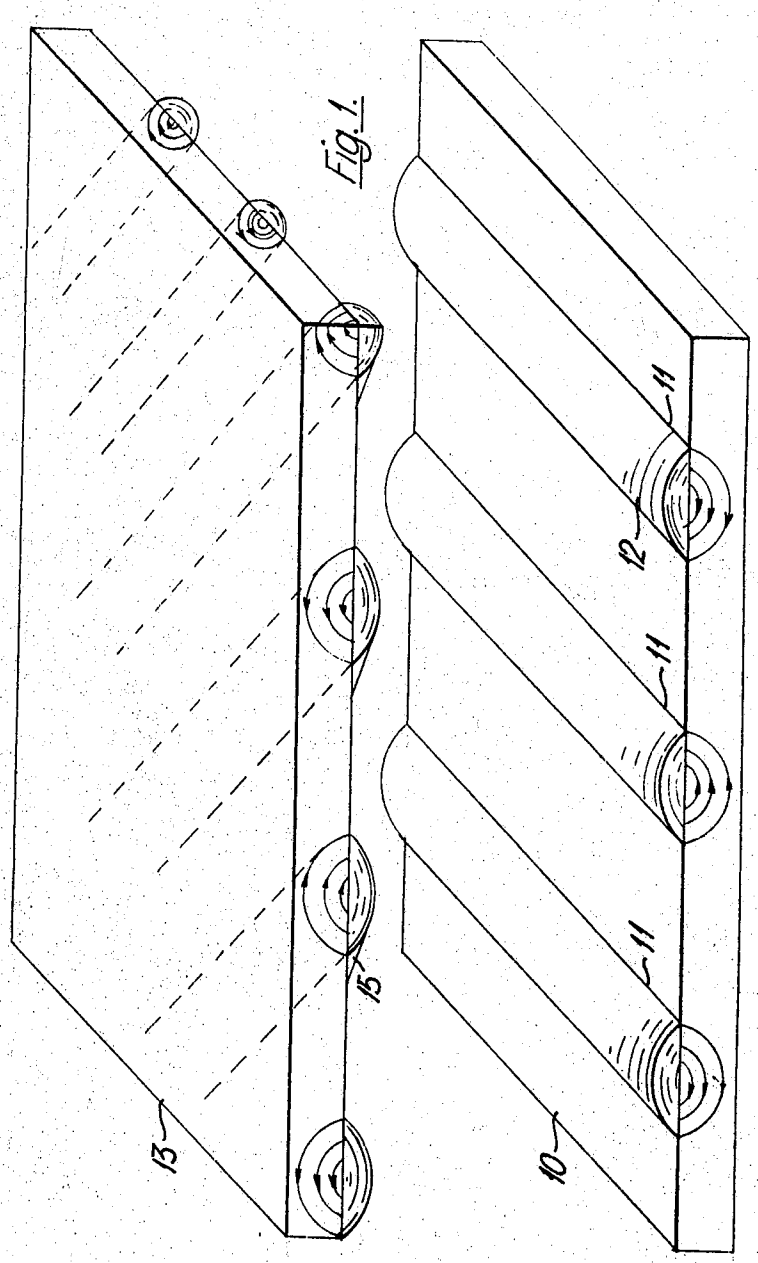


Fig. 1.

Inventor
ROBERT J. HODGES
By Mark L. Hopkins
Agent

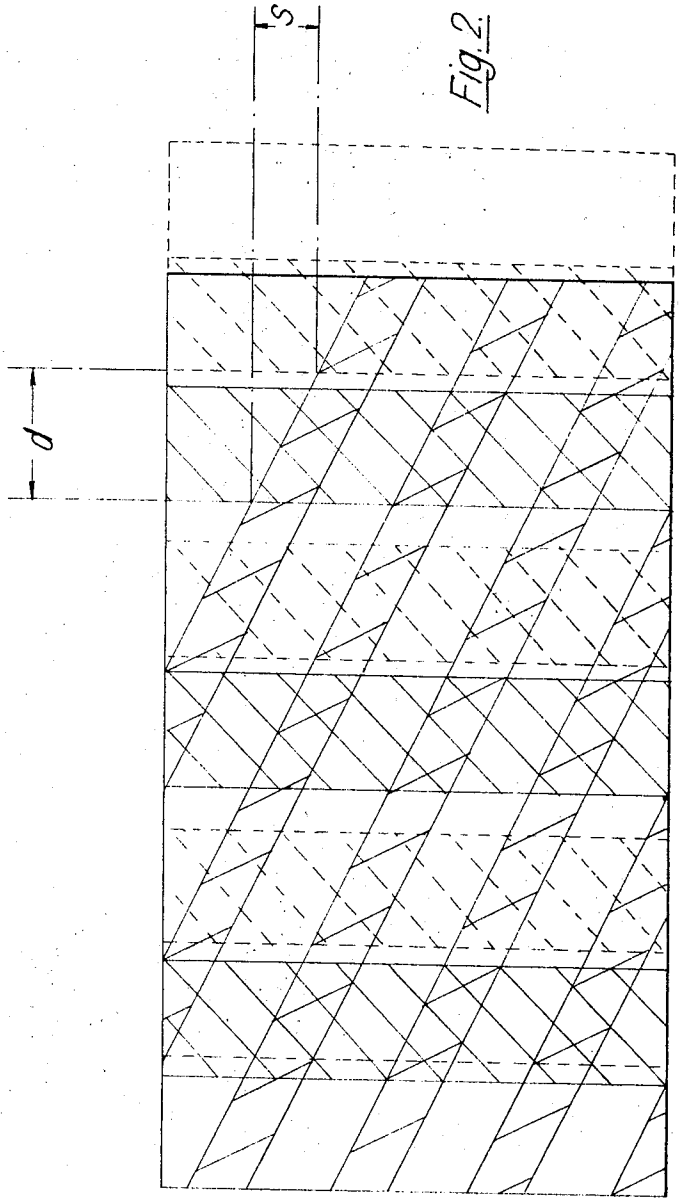


Fig. 2.

Inventor
ROBERT J. HODGES
By Mark L. Hopkins
Agent

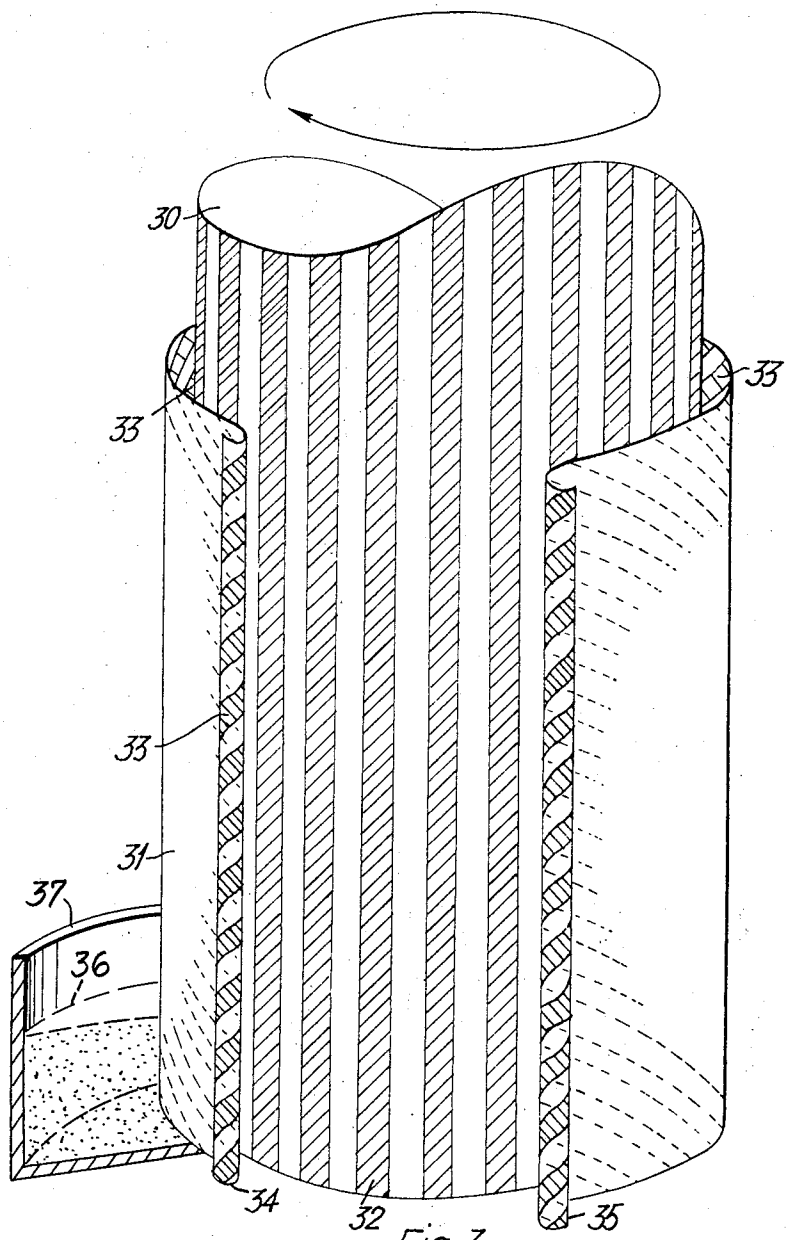


Fig. 3.

Inventor
ROBERT J. HODGES

By Wm. L. Hopkins
Agent

MAGNETIC POWER HANDLING ARRANGEMENT

BACKGROUND OF THE INVENTION

This invention relates to magnetic powder transport mechanisms. It finds particular, but not necessarily exclusive, application in electrographic nonpercussive printing in which it may be employed to transport magnetic printing ink so as to cover a powder transfer roller with a substantially uniform thickness layer of ink.

SUMMARY OF THE INVENTION

According to the invention there is provided a magnetic powder transport mechanism including a first body having a surface in close proximity to a surface of a second body and adapted for movement relative thereto without altering the separation between said surfaces, wherein each said surface is magnetized to produce a set of discrete strips thereon to which magnetic powder will adhere, and wherein the strips of one surface cross those of the other surface and the strips of both surfaces are inclined to the direction of relative movement of the surfaces.

There follows a discussion of how magnetic powder is transported in accordance with the principles of the present invention, and a description of a magnetic powder transport mechanism embodying the invention in a preferred form. This mechanism forms part of an electrographic nonpercussive printer in which it is used to distribute an even coating of ink over a powder applicator roller employed for inking a latent magnetic image formed upon a magnetizable surface. In this apparatus the powder applicator roller itself forms part of the powder feed mechanism.

A feature of this magnetic powder transport mechanism used as a powder applicator is that it enables powder to be taken from a reservoir and applied to a latent magnetic image without recourse to the use of air pressure to fluidize the powder. This if of particular advantage because the use of air pressure in conjunction with a magnetic powder is liable to provide considerable problems in preventing powder entrained in eddies from lodging in places where it is not wanted and where its abrasive nature can cause damage.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the invention will be better understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a perspective view of two sheets of magnetic material magnetized so that magnetic powder will adhere thereto in rib-like strips;

FIG. 2 is a diagram showing the effect produced by relative movement of the two sheets of FIG. 1; and

FIG. 3 depicts a perspective view of a powder transport mechanism embodying the invention in a preferred form.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The manner by which magnetic powder can be transported in accordance with the principles of the present invention is illustrated with reference to FIGS. 1 and 2. In FIG. 1 there is shown a sheet 10 of magnetic material magnetized in such a way as to provide a set of discrete parallel strips 11 to which magnetic powder will adhere in ribs 12. In this figure there is also depicted a second

sheet 13 of magnetic material, similar to the first, this sheet 13 being magnetized in such a way as to provide a set of parallel strips on its under side to which powder will adhere in ribs 15. The orientation of the two sheets is chosen so that they occupy parallel planes with the ribs 12 of the first sheet inclined at an angle to the ribs 15 of the second sheet. It will be realized that the magnetic powder constituting any one of these ribs can be moved relatively easily along the magnetized strip to which it adheres, but rather less easily from that strip to an adjacent one on the same sheet because in doing so it would have to surmount a potential barrier. If now the two sheets are brought into close proximity so that they are separated by a distance just less than twice the depth of powder in a single rib, and furthermore if one sheet is then moved relative to the other while maintaining a constant separation between them, then at least a proportion of the magnetic powder at each intersection of the ribs will tend to move along the ribs so as to maintain itself in the region of that intersection.

The phenomenon may be more readily understood by reference to FIG. 2 which is a diagrammatic representation of the two sheets of FIG. 1. In FIG. 2 the initial position of sheet 10 is shown in dotted detail and its final position, after a lateral translation by a distance *d*, is shown in full detail. Any of the powder which maintains its position relative to an intersection during this lateral translation is seen therefore also to have been caused to make a translation of distance *s* up the plane of the page.

Thus it can be seen that relative movement of two appropriately magnetized substrates in one direction can be used to produce a net transport of magnetic powder in another direction. In order to achieve this effect it is not necessary to employ a magnetic configuration in which each substrate is provided with a regularly spaced set of parallel strips, for it is clear that they could be curved, and the strips of one substrate could incline one to another, so long as the strips of each substrate define intersecting regions with those of the other substrate, and so long as the direction of relative movement of the two substrates is not in line with either set of strips.

A particularly useful geometry of substrates is provided by a cylinder rotatable upon its axis with its curved surface in close proximity to a co-operating substrate partially or completely surrounding the curved surface of the cylinder. With this arrangement, and with a substantially helical disposition of magnetic strips in at least one of the substrates, magnetic powder can be given an axial component of movement by rotating the cylinder upon its axis. The manner in which the powder is provided with an axial component of movement is somewhat analogous to the way in which a domestic mincing machine material is caused to be advanced towards the cutters.

This geometry of substrates is employed in the powder applicator now to be described with reference to FIG. 3. The operational parts of the powder applicator consist of a roller 30 held with its axis vertical and embraced by a curved shield 31.

The curved surface of the roller 30 and the inside surface of the curved shield 31 are each faced with a sheet of magnetic rubber which has been magnetized so that magnetic powder will adhere to it in strips having a pitch of approximately one eighth of an inch. In the case of the roller, the orientation of the rubber sheet is

such that the strips 32 are substantially parallel with the axis of the drum, while in the case of the shield the orientation of the rubber sheet is such that the strips 33 are helically disposed.

The lower end of the assembly of roller 30 and shield 31 is arranged to dip beneath the level of magnetic powder contained in a suitable powder reservoir. If the roller is then rotated in the direction shown by the arrow in FIG. 3, a certain amount of the powder at the base of the roller which has been attracted to the strips 32 is caused to travel upwardly along those strips while it is in contact with powder which has been attracted to strip 33 on the shield. There is of course no tendency for any powder to move up any strip while that strip is traversing the gap between the side edges of the shield indicated at 34 and 35, but once the strip moves beyond the gap the tendency for upward movement is restored.

Insofar as any elemental magnetized area of the roller is able to retain by magnetic attraction only a limited amount of magnetic powder, actual transport of the powder will only occur if this can be effected without causing more powder to accumulate at any point on the roller than can be magnetically retained at that point. Therefore rotation of the roller causes powder to be transported up it until its strips are covered with powder to a substantially uniform depth throughout the axial length embraced by the shield. This roller is used for applying the magnetic powder to a latent magnetic image formed on a vertically-held surface which is caused to move past the gap defined by edges 34 and 35 of the shield. At its closest approach to the roller this vertically-held surface is spaced from the roller by a distance approximately equal to the depth of powder retained by the roller. In this way, as the rib of powder which has been attracted to each strip 32 of the roller passes across the gap, it lightly dusts the surface with magnetic powder so that powder will be transferred to that surface in any regions of magnetic gradient formed therein. The loss of powder from the roller occasioned by this transfer is made good by powder transported up the roller from the powder reservoir.

The above description has not specified the separation between the shield and the roller because this is a function not only of the magnetic properties of the roller and the shield but also of the magnetic powder with which they are used. The appropriate separation is however relatively easily determined in any particular practical example by dipping the roller and the shield into the powder to be used, determining the depth of powder which adheres to each, and then making the separation just less than the sum of these two depths. A typical value for this separation is an eighth of an inch.

In FIG. 3, a reservoir 37 is shown for magnetic powder 36.

It is to be understood that the foregoing description of specific apparatus is made by way of example only and is not to be considered as a limitation on the scope of this invention.

I claim:

1. A magnetic powder handling apparatus for transporting magnetic powder from a reservoir and applying same to a recorded image on a magnetizable recording medium, comprising first and seoond bodies having lower ends of both bodies in contact with the magnetic powder in the reservoir, the first body having a surface in close proximity to a surface of the second body and adapted for movement relative thereto without altering the separation between said surfaces, each said surface being magnetized to produce a set of discrete strips thereon to which magnetic powder will adhere, the strips of one surface crossing those of the other surface so as to form a plurality of intersections and the strips of both surfaces being inclined to the direction of relative movement of the surfaces.

2. The powder transport arrangement as claimed in claim 1 wherein said surfaces of either or both bodies are provided by the surfaces of sheets of magnetic rubber.

3. The magnetic powder transport arrangement as claimed in claim 1 wherein the members of each set of strips are regularly spaced.

4. The magentic powder transport arrangement as claimed in claim 1 wherein the surface of said first body is the curved surface of a cylinder rotatable about its axis.

5. The powder transport arrangement as claimed in claim 4 wherein the set of strips on at least one of said surfaces are helically disposed.

6. The powder transport arrangement as claimed in claim 5 wherein the set of strips on the curved surface of the cylinder are disposed in the axial direction.

7. The magnetic powder transport arrangement as claimed in claim 6 wherein the surface of said second body embraces but does not completely surround the curved surface of the cylinder.

8. A magnetic powder handling arrangement for transporting magnetic powder from a reservoir and applying same to a recorded image on a magnetizable recording medium, comprising a first surface arranged in close proximity to the recording medium, said first surface having arranged therein a set of magnetic strips capable of attracting magnetic powder, one end of said first surface being in continual contact with the magnetic powder in the reservoir, and a second surface also having a set of magnetic strips arranged therein capable of attracting magnetic powder, said second surface being arranged to be substantially parallel to said first surface and also having one end thereof in continual contact with the powder in the reservoir, said surfaces being arranged to face each other and adapted for relative movement therebetween, with the magnetic strips of one surface arranged to cross the other so as to form a plurality of intersections and further arranged to be inclined with the relative direction of movement between said surfaces, the second surface being so constructed as to expose a portion of said first surface to the recording medium in order for the magnetic powder to be applied to the recording medium.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,777,707 Dated December 11, 1973

Inventor(s) Robert James Hodges

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title of invention should read -- MAGNETIC POWDER HANDLING ARRANGEMENT --.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

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