

[72] Inventor **Clyde O. Childress**
Palo Alto, California
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 [73] Assignee **Monsanto Graphics Systems, Inc.**
St. Louis, Missouri
a corporation of Delaware

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Primary Examiner—Edgar S. Burr
Attorney—Samuel Lindenberg and Arthur Freilich

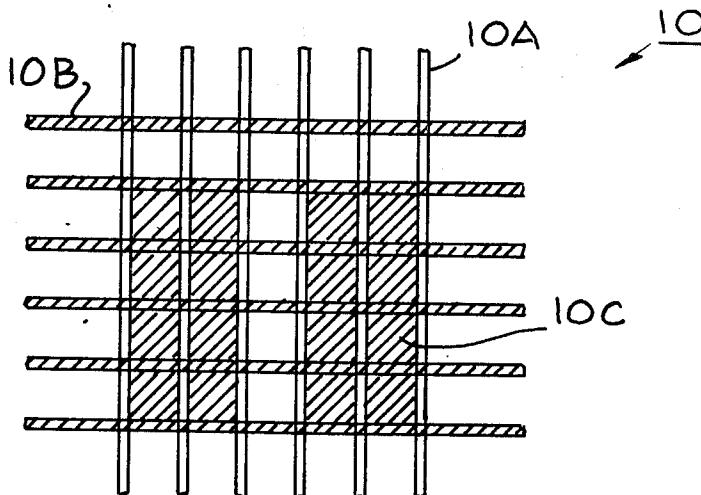
[54] **IMAGE ELECTRODE FOR ELECTROSTATIC PRINTING**
8 Claims, 3 Drawing Figs.

[52] U.S. Cl. **101/127,**
 245/2; 101/368
 [51] Int. Cl. **B41m 1/24**
 [50] Field of Search 245/2;
 101/114, 129, (ESD), 127, 368

[56] **References Cited**
UNITED STATES PATENTS

3,081,698	3/1963	Childress et al.	101/(ESD)
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ABSTRACT: In one type of electrostatic printing an image desired to be printed is formed with electroscopic powder particles which are thereafter transported by means of an electric field to a receiving substrate. The image forming electrode may be a screen having closed apertures and open apertures which are in the form of the desired image, or may be a plate which has surface indentations or wells arranged in the form of an image. The electroscopic powder is first deposited in the wells and thereafter transferred to the substrate. In accordance with this invention an image electrode is conductive along one axis and resistive along the other axis. Stated another way, there is provided in accordance with this invention an anisotropic conductive image electrode for electrostatic printing.



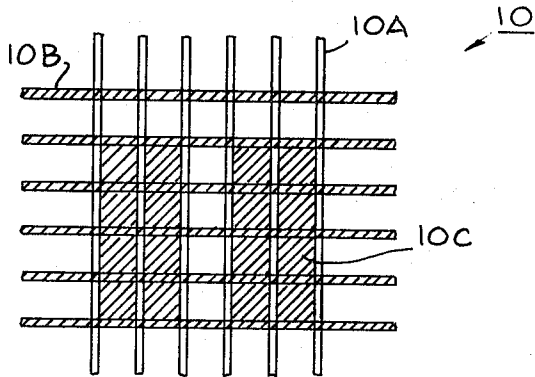


Fig. 1

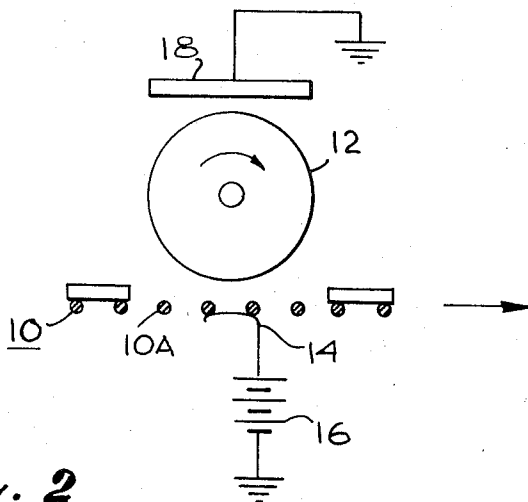


Fig. 2

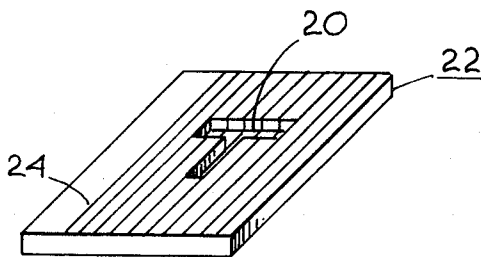


Fig. 3

INVENTOR
CLYDE O. CHILDRESS
BY *Lundberg & Friebe*
ATTORNEY

IMAGE ELECTRODE FOR ELECTROSTATIC PRINTING

BACKGROUND OF THE INVENTION

This invention relates to electrostatic printing systems and more particularly to improvements in the image electrode employed in electrostatic printing.

In the practice of electrostatic printing of the type using an image electrode, the image electrode may be made of a metal or conductive screen which is thin and flexible. The screen is usually covered over except for those areas which define the image desired to be printed. The screen is supported out of contact with an image receiving electrode, which is spaced therefrom. A source of potential is connected to the image receiving electrode and the image electrode. It is often difficult to maintain the spacing between the electrodes due to the attractive force exerted by the electrical field used to activate the transfer of the powder particles which are normally applied to the back of the image screen in the region of the openings. These attractive forces assume significant strength when image electrodes of large sizes are positioned in overall parallel juxtaposition.

For example, the force between two parallel electrodes exerted by a field strength of 80 volts per mil is 0.006 pounds per square inch. If one of these electrodes is a screen 24 inches wide, held by two edges with a tension of 12 pounds per inch, this force is sufficient to produce a center sag of 0.072 inches.

An additional problem which is encountered in electrostatic printing of the type described, occurs in the transfer of images from a flat screen to a cylindrical screen, or from a cylindrical image element to a flat surface where a limited area of the cylindrical member is brought into progressive or rolling juxtaposition to the opposing member so that the image transfer is confined to that area in closest juxtaposition to the image electrode. In such cases it is often difficult to prevent the powder from transferring in areas other than the desired ones which are in closest juxtaposition. This can cause a poor print.

In the removal of powder from a screen, after the screen has passed through the printing location, vacuuming or wiping techniques are employed. The removed powder is either thrown away or if recovery thereof is desired, complex filtering for cleansing must be performed.

An object of this invention is the provision of an image electrode which minimizes the problem of deformation due to the presence of the electrical field.

Another object of this invention is the provision of a construction for an image electrode wherein the problem of premature powder transfer are minimized. Yet another object of the present invention is the construction of an image electrode for electrostatic printing which enables easier cleaning. Still another object of the present invention is the provision of a novel and useful image electrode.

SUMMARY OF THE INVENTION

The foregoing and other objects of the invention may be achieved in constructing the image electrodes so that considering it as a planar structure, it is conductive along one axis and resistive or substantially nonconductive along another axis. This may be done in the case of an image screen by having a warp of metallic filaments and a woof of resistive monofilament polymer to which a suitable nonconductive image defining mask can be adhered. In the case of intaglio type of image electrode structure, one may obtain conductivity by using a base of nonconductive material on which a grid of conductive strips may be laid by printed circuit technique or by actually cutting grooves and depositing conductive filaments therein.

The novel features of the invention are set forth with particularity in the appended claims. The invention will best be understood from the following description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of an image screen constructed in accordance with this invention.

FIG. 2 exemplifies the image screen being used in an electrostatic printing system.

FIG. 3 represents another construction for an image electrode in accordance with this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An image screen 10, in accordance with this invention is shown in FIG. 1. The warp of the screen will be woven with metallic filaments 10a designated in the drawing as conductive. The woof of the screen may be resistive monofilament polymers 10b. The screen has certain apertures 10c which are blocked so that the area of the open apertures defines the letter T.

The screen described may be considered as conductive in one direction and nonconductive in the direction orthogonal to that one direction. The difference in resistivity need not be as great as that obtained with the indicated materials. It is only necessary that there be a substantial difference in conductivity between the two directions or between the warp and the woof. The effect of the difference in conductivity may be appreciated from the fact that as pointed out previously for an 80 volt per mil electric field, a center sag of .072 inches was experienced. With all other conditions being the same, a screen made up in accordance with this invention and addressed with the appropriate potentials would reduce the center sag to approximately 0.003 inches. The reason that this occurs is obviously because the electric field is considerably lessened since the field is established only in the active printing areas. This however does not adversely effect the ability of the structure to transport powder particles across the space between the image screen and the image receiving substrate. It appears that the field established by the structure described is adequate for the purpose intended.

FIG. 2 shows a typical application of the structure for nip printing. The image screen 10 travels in the direction indicated by the arrow. A cylindrical image receiving object 12 is in the space between the screen and a back electrode 14. Powder is applied to the back side of the screen which is the same side as that to which a potential applying electrode 14 is connected. This is connected to a source of potential 16 which is grounded. The electrode contacts only the conductive edge of the screen. Powder, not shown, may be applied by a suitable powder delivery mechanism, such as a brush, or the screen may be precoated with powder in the manner described in Pat. No. 3,340,803. Because of the localization of the field potential the tendency of the powder to release prematurely, before reaching the region of the nip of the image receiving object 12, which is the surface closest to the screen, is substantially minimized.

FIG. 3 shows a proposed construction for those image electrodes in which the powder image is formed in a depression 20 within the image electrode 22. Here, the base material may be nonconductive or resistive. It may be a plastic material. Stripes of conductive material 24 may be laid down in the surface of the base material by any suitable means such as by printed circuit deposition, line rulings with conductive ink, or by cutting parallel lines in the surface of the material and inserting thin wires therein. The conductive lines 24 need only be placed in the region of the image-shaped depression 20.

In the arrangement described the electric field is applied between the image screen and the opposite electrode only in the region wherein it is required to be used. With screens which are isotropically conductive, such as those used in the prior art, when the screen was contacted at one point, the entire screen, because of its construction had the potential applied thereover. The present invention by reason of its anisotropic conductive properties, is only conductive on those strands to which the potential applying contact is actually applied. This means that the region of attraction by the applied electric field between the image electrode and the opposite electrode is considerably reduced with a considerable reduction in the image screen sag due to this field. Since the field only occurs in the region where printing is desired, there is no

premature release of powder which is applied to the screen prior to the screen being moved into the printing position. Since the screen is not electrified in regions past the image transfer station, the removal of the powder from the screen is not impeded by the effects of screen potential. The powder can be very easily mechanically removed and re-used.

There has accordingly been described and shown herein a novel, useful and simple improvement in the construction of image electrodes which can be used for electrostatic printing.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art and consequently it is intended that the claims be interpreted to cover such modifications and equivalents.

I claim:

1. An improved image electrode for an electrostatic printing system of the type wherein an electric field is established between the image electrode and a backplate by applying a voltage between said image electrode and backplate, and wherein it is desired to maintain uniform spacing between said image electrode and said backplate while maintaining an electric field thereover, said image electrode comprising:

a structure having openings in the form of a powder image desired to be printed;
said structure having a plurality of spaced electrical conductors extending in one direction along said structure; and
resistive means, which are substantially nonconductive when compared to the conductivity of said spaced electrical conductors, spacing said spaced electrical conductors, said resistive means electrically insulating adjacent ones of said spaced electrical conductors from each other.

2. An image electrode as recited in claim 1 wherein said image electrode is in the form of a screen said spaced conductors constitute the warp of said screen and said resistive means constitutes the woof of said screen.

3. An image electrode as recited in claim 1 wherein said image electrode is in the form of an intaglio plate made from resistive material, and said spaced conductors are imbedded in the surface of said plate.

4. An image electrode as recited in claim 1 wherein said resistive means comprises a resistant monofilament polymer

field thereover, said image electrode comprising:

a structure having openings in the form of a powder image desired to be printed;

said structure having a plurality of spaced electrical conductors extending in one direction along said structure; and
resistive means, which are substantially nonconductive when compared to the conductivity of said spaced electrical conductors,

5. An image electrode for electrostatic printing comprising:
a sheet of resistive material having openings therein which have the shape of images desired to be printed; and
a plurality of parallel spaced electrical conductors which are highly conductive when compared to the conductivity of said resistance means distributed on one surface of said sheet, said electrical conductors being electrically insulated from each other by said sheet.

6. In an electrostatic printing system of the type wherein a powder image electrode is spaced from a conductive electrode and a potential source is connected between the two to establish an electric field for carrying powder from the image electrode towards the conductive electrode, the improvement comprising:

a powder image electrode having spaced electrical conductors extending along one direction of said electrode;
resistive means, which are substantially nonconductive when compared to the conductivity of said electrical conductors, spacing said spaced electrical conductors, said resistive means electrically insulating adjacent ones of said spaced electrical conductors from each other; and
means for connecting said potential source to said image electrode spaced electrical conductors only in the region desired for printing.

7. In an electrostatic printing system as recited in claim 6 wherein said image electrode is in the form of a screen, said spaced conductors constitute the warp of said screen and said resistive means constitutes the woof of said screen.

8. In an electrostatic printing system as recited in claim 6 wherein said image electrode is in the form of an intaglio plate made from resistive material, and said spaced conductors are imbedded in the surface of said plate.

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