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54 **Method of printing dot-on-dot graphics area-fill using an ink jet device.**

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Description

TECHNICAL FIELD

The present invention relates to ink-jet devices for printing colors on a print medium, and, more particularly, to a method of improving the perceived quality of color graphics thereon.

BACKGROUND ART

Ink-jet devices fire droplets of ink toward a printing medium, such as paper or mylar. Typical ink-jet printheads comprise at least one group of nozzles, called a primitive, through which the droplets of ink are fired. For full color printing, three primitives are employed, with the nozzles of each fluidically connected to a reservoir of a different color ink (cyan, yellow, magenta). The firing, or propelling of ink droplets, may be done by piezoelectric means or by resistive heating (thermal).

In green, red and blue solid area-fill, the colors are generated by placing one dot of a first color on top of another dot of a second color, which produces the desired third color (e.g., yellow on cyan creates green).

In the normal printing mode, the dots are put down on each other in the same pass of the printhead across the medium. When printing a block of area-fill, bands occur between swaths of print rows, due to absorption of the first colour printed on the medium, which may be a specially coated paper used for colour ink-jet printing. The banding tends to reduce the perceived quality of the output.

GB-A-2119549 discloses a dot-on-dot printing method as described above and as particularly described herein with reference to figs. 1a-1d of the accompanying drawings.

Accordingly, a method of producing a substantially uniform block of colour, without the perceived banding or at least with reduced perceived banding is desired.

DISCLOSURE OF INVENTION

In accordance with the invention, a method of forming dot-on-dot graphics area-fill with reduced perceived banding is provided.

In particular, the invention provides a method of generating dot-on-dot graphics area fill on a print medium using an inkjet device including at least one printhead having a set of primitives, each primitive comprising a plurality of nozzles fluidically connected to a reservoir of a given colour, the method comprising:

- printing a first row of a first colour;
- printing a second row of a second colour; and
- printing further rows of alternating first and sec-

ond colours, each further row of each colour being contiguous with the previous row of that colour;

characterised in that each row of the second colour is offset from its respective row of the first colour by a predetermined displacement toward the previous row of the first colour.

The offset printing may be done by moving either the print medium or the printhead relative to the other. Also, primitives on the printhead may be staggered to achieve the desired effect.

By overlapping, or interleaving, swaths of the individual colours, the bands present in the conventional print mode are eliminated. This results in improved print quality and homogeneity of graphics output.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1a-d are top plan views of printing two colours to achieve a third colour, employing a conventional print mode used in the prior art; and

FIGS. 2a-e are top plan views of printing two colours to achieve a third color in accordance with the invention.

BEST MODES FOR CARRYING OUT THE INVENTION

Referring now to the drawings wherein like numerals of reference designate like elements throughout, FIGS. 1a-d depict the sequence of events in filling in an area of a third color achieved by printing multiple rows of two colors. In the description which follows, the color green is achieved by printing alternating rows of cyan and yellow. However, it will be understood that other combinations suffer from the same effect to be described, and that such other combinations will also benefit from employing the method of invention.

FIG. 1a illustrates the printing of a first row 10 of a first color, here, cyan, on a print medium 12. Employing ink-jet technology, the row 10, and subsequent rows, are generated by firing all nozzles of a primitive on the printhead. As an example, a primitive may contain ten nozzles, although fewer or greater numbers of nozzles may be employed.

In FIG. 1b, a row 14 of a second color, here, yellow, is overlaid directly over the first row 10, either in the same pass across the medium 12 or in a subsequent pass. However, the print medium 12 is saturated with the first color, so the second color tends to run off the first color, creating the third color in the central portion 16 and a border 18 of the second color.

In FIG. 1c, a second row 20 of the first color is printed, and its top edge is aligned substantially adjacent the bottom edge of the first row 10 of the first color. While that portion 22 of the border 18 overlaid by the second row 20 suffers from the saturation effects discussed in connection with FIG. 1a, it never-

theless is converted to the third color. However, whereas the central portion 16 comprises the second color on top of the first color, the border portion 22 comprises the first color on top of the second color. This distinction will be discussed shortly.

In FIG. 1d, another row 24 of the second color is overlaid directly over the second row 20. Again, due to saturation of the print medium, the third color is generated in the central portion 16', and a border 18' of the second color is formed, as in FIG. 1b.

It will be appreciated that printing of subsequent rows of the first color overlaid with rows of the second color generates two regions of a third color, namely a central portion 16 (and 16', etc.) and a border portion 22 (and 22', etc.). While both are of the same color, the former region is a third color of the case of the first color (due to the prior absorption of the first color therein), while the latter region is a third color of the cast of the second color (due to the prior absorption of the second color therein).

Thus, in the case of rows 10, 20 of cyan overlaid with rows 14, 24 of yellow, the central portions 16, 16' are green with a bluish cast, while the border portions 22, 22' are green with a yellowish cast. The resulting area-fill comprises large swaths of one shade of green separated by narrow bands of another shade of green. The distinct banding is considered objectionable.

In accordance with the invention, the perceived quality of the area fill is improved by overlapping, or interleaving, swaths of the individual colors. The preferred sequence of the overlapping is depicted in FIGS. 2a-e.

FIG. 2a shows a first row 30 of a first color, again, cyan, for example, printed on a medium 12. A complete first row is printed. Region "A" comprises the first color.

In FIG. 2b, only a portion of a second row 32 of a second color, again, yellow, for example, is printed, offset from the first row by a specific, predetermined amount. The portion (region "A") not printed by the second color relates to the amount of overlap, or offset, and here is one-half of a row. Thus, one-half row is initially printed, and the offset is one-half row, so that the second row 32 covers the top one-half of the printed portion of the first row 30. The row 32 creates the third color, again, green, for example, while the bottom half of the row 30 remains the first color. Region "B" is now the third color, while that portion of region "A" not printed on is denoted "A'".

In FIG. 2c, a third row 34 of the first color is printed adjacent the row 30, again, offset from the second row 32 by the predetermined amount, here, one half row. Thus, the top of row 34 butts against the bottom of row 30. Region "B", being unaffected in this step, remains the third color, region "A'", also unaffected, remains the first color, and region "A" is the newly-printed first color.

In FIG. 2d, a fourth row 36 of the second color is printed, offset from the third row 34 by the predetermined amount, again, one-half row. Region "B", being unaffected in this step, remains the third color, region "A" and the upper portion of region "A" are now the third color, as denoted by "B", and the lower portion of region "A" not printed on is denoted "A'", the first color.

The method may be continued as many times as desired printing of rows of alternating first and second colors, until the area is filled. In order to terminate the last row of the area to provide only one color, only a portion of the last row is printed, and is the amount of offset, here, one-half of a row 38, as shown in FIG. 2e.

It will be appreciated that in the preferred embodiment, one color (the first color, here, cyan) is always overlaid by another color (the second color, here, yellow) so that the resulting third color is always of the same cast. Thus, the objectionable banding achieved with the prior art method is avoided.

The offsetting of one color relative to another color can be done using several methods. First, individual primitives on a single printhead containing separate colors can be physically offset relative to each other. Second, if the primary colors are contained in separate pens, the pens themselves can be offset relative to one another. Third, with a printhead having primitives not offset, or with a pen fixturing configuration not having the pens offset, less than the full number of nozzles in each primitive, or pen, can be used in order to allow for offsetting of the remaining nozzles.

The third method allows for offsetting without having to make a physical change to an existing pen or to the pen fixturing (in the case when each color is in a separate pen).

By physically offsetting the nozzles of one color relative to the nozzles of the other color using any of the methods stated previously, the two colors can be deposited during the same pass of the printhead across the medium. In FIG. 2, this would be accomplished by depositing the rows 30 and 32 represented in FIGS. 2a and 2b in the same pass, as well as the rows 34 and 36 represented in FIGS. 2c and 2d during the same pass.

Two additional methods can be used to create the offset of the two colors. In the fourth method, the print medium 12 can be moved relative to the printhead. In the fifth method, the printhead can be moved relative to the print medium 12. These methods require that the medium or printhead, depending on which is being moved, move backward (opposite the direction of the progression of printing down the page) to allow for the offsetting of the second color relative to the first color. The printhead or medium must be then moved forward to deposit the first color on an unprinted section of medium again, then move backward to print the second color, and continue in this fashion until the

area-fill block is complete. Thus, these methods require that one pass of the printhead across the medium be made for each primary color deposited.

The advantage of printing the first and second colors during the same pass of the printhead or printheads across the medium is that the time required to print a section of area-fill is approximately halved. However, with the offset configuration, the print quality is better when the section is printed in two pass modes rather than in a single pass mode. The reason for this is that one section of the third color is created by combining the first and second colors in the same pass, and another section is created by depositing the second color on top of the first color which was deposited in the previous pass of the printhead across the medium. The difference creates a variation in hue between the two sections, which is noticeable.

In the two-pass mode, the second color is deposited on two sections of the first color. One section was deposited in the previous pass, and the other was put down three passes prior to the pass of the second color. The two sections of the first color are very similar, since both have had sufficient time to dry, and result in a uniform area of the third color.

The extent of offset may be varied. In the one-pass mode, maximum print quality is achieved at an offset of 100%, while slight improvement is made with slight amounts of offset of at least about 10%. In the two-pass mode, maximum print quality is achieved at an offset of 100% also, but major improvements are obtained with slight amounts of offset, of at least about 10%.

Claims

1. A method of generating dot-on-dot graphics area fill on a print medium (12) using an inkjet device including at least one printhead having a set of primitives, each primitive comprising a plurality of nozzles fluidically connected to a reservoir of a given colour, the method comprising:

printing a first row (30) of a first colour (c);
printing a second row (32) of a second colour (y);
and

printing further rows (34, 36) of alternating first and second colours, each further row of each colour being contiguous with the previous row of that colour; characterised in that each row (32; 36) of the second colour is offset from its respective row (30; 34) of the first colour by a predetermined displacement toward the previous row of the first colour.

2. The method of claim 1 wherein the predetermined displacement is at least about 10% of a row.

3. The method of claim 2 wherein the predetermined displacement is up to 100% of a row.

4. The method of claim 2 wherein the predeter-

mined displacement is one-half of a row.

5. The method of any preceding claim wherein the displacement is achieved by moving the medium with respect to the printhead.

6. The method of any preceding claim wherein the displacement is achieved by moving the printhead with respect to the medium.

7. The method of any preceding claim wherein the displacement is achieved by staggering the primitives with respect to each other.

8. The method of any preceding claim wherein printing commences with printing the first row, followed by printing a portion of the second row, and terminates with printing a lower portion of the last row (38) coinciding with the amount of offset of the penultimate row.

9. The method of claim 8 wherein printing commences with printing the bottom half of the first row and terminates with printing the upper half of the last row.

10. The method of any preceding claim wherein the rows of alternating first and second colours are printed in one pass of the said at least one printhead across the print medium.

11. The method of any preceding claim wherein the rows of alternating first and second colours are printed in two passes of the said at least one printhead.

Patentansprüche

1. Verfahren zur Erzeugung graphischer Punkt-auf-Punkt Füllflächen auf einem Druckmedium (12) unter Verwendung eines Tintenstrahlgerätes mit mindestens einem Druckkopf mit einem Satz von Düsengruppen, von denen jede mehrere bezüglich Flüssigkeiten mit einem Reservoir einer gegebenen Farbe verbundene Düsen aufweist, mit den Verfahrensschritten:

Drucken einer ersten Zeile (30) aus einer ersten Farbe (c),

Drucken einer zweiten Zeile (32) aus einer zweiten Farbe (y)
und

Drucken weiterer Zeilen (34, 36) mit abwechselnd der ersten und der zweiten Farbe, wobei jede weitere Zeile jeder Farbe an die vorherige Zeile dieser Farbe angrenzt,

dadurch gekennzeichnet, daß Jede Zeile (32, 36) aus der zweiten Farbe gegenüber ihrer entsprechenden Zeile (30, 34) aus der ersten Farbe um einen vorgegebenen Versatz in Richtung der vorherigen Zeile aus der ersten Farbe versetzt ist.

2. Verfahren nach Anspruch 1, bei dem der vorgegebene Versatz mindestens etwa 10% einer Zeile beträgt.

3. Verfahren nach Anspruch 2, bei dem der vorgegebene Versatz bis zu 100% einer Zeile beträgt.

4. Verfahren nach Anspruch 2, bei dem der vorgegebene Versatz eine halbe Zeile beträgt.

5. Verfahren nach einem der vorangehenden Ansprüche, bei dem der Versatz durch Bewegen des Druckmediums gegenüber dem Druckkopf erreicht wird.

6. Verfahren nach einem der vorangehenden Ansprüche, bei dem der Versatz durch Bewegen des Druckkopfes gegenüber dem Druckmedium erreicht wird.

7. Verfahren nach einem der vorangehenden Ansprüche, bei dem der Versatz durch Versetzen der Düsengruppen gegeneinander erreicht wird.

8. Verfahren nach einem der vorangehenden Ansprüche, bei dem das Drucken mit Drucken der ersten Zeile beginnt, darauf ein Abschnitt der zweiten Zeile gedruckt wird, und mit Drucken eines unteren Abschnittes der letzten Zeile (38) endet, die mit dem Offsetwert der vorletzten Zeile zusammenfällt.

9. Verfahren nach Anspruch 8, bei dem das Drucken mit Drucken der unteren Hälfte der ersten Zeile beginnt und mit Drucken der oberen Hälfte der letzten Zeile endet.

10. Verfahren nach einem der vorangehenden Ansprüche, bei dem die Zeilen aus abwechselnd der ersten und der zweiten Farbe in einem Gang des mindestens einen Druckkopfes über das Printmedium gedruckt werden.

11. Verfahren nach einem der vorangehenden Ansprüche, bei dem die Zeilen aus abwechselnd erster und zweiter Farbe in zwei Durchgängen des wenigstens einen Druckkopfes gedruckt werden.

Revendications

1. Un procédé de génération d'un remplissage d'une surface de graphique point-sur-point d'un milieu (12) à imprimer en utilisant un dispositif à jet d'encre comprenant au moins un tête d'impression comportant un jeu d'éléments primitifs chaque élément primitif comportant plusieurs ajutages reliés de manière fluide à un réservoir d'une couleur donnée, le procédé comprenant les étapes consistant à :

imprimer une première ligne (30) d'une première couleur (c);

imprimer une deuxième ligne (32) d'une deuxième couleur (y);
et

imprimer d'autres lignes (34, 36) des première et deuxième couleurs en alternance, chaque autre ligne de chaque couleur étant contigüe à la rangée précédente de cette couleur;

caractérisé en ce que chaque ligne (32; 36) de la deuxième couleur est décalée, par rapport à sa ligne respective (30; 30) de la première couleur, d'un décalage prédéterminé vers la ligne précédente de la première couleur.

2. Le procédé selon la revendication 1 dans lequel le décalage prédéterminé est d'au moins environ 10% d'une ligne.

3. Le procédé selon la revendication 2, dans lequel le décalage prédéterminé peut atteindre 100% d'une ligne.

4. Le procédé selon la revendication 2, dans lequel le décalage prédéterminé est d'une moitié d'une ligne.

5. Le procédé selon une revendication précédente quelconque dans lequel le décalage est réalisé en déplaçant le milieu par rapport à la tête d'impression.

6. Le procédé selon une revendication précédente quelconque dans lequel le décalage est réalisé en déplaçant la tête d'impression par rapport au milieu.

7. Le procédé selon une revendication précédente quelconque dans lequel le décalage est obtenu par un échelonnement des éléments primitifs l'un par rapport à l'autre.

8. Le procédé selon une revendication précédente quelconque dans lequel l'impression commence par l'impression de la première ligne, suivie par l'impression d'une partie de la deuxième ligne, et se termine par l'impression d'une partie inférieure de la dernière ligne (38) en coïncidence avec l'ampleur du décalage de l'avant dernière ligne.

9. Le procédé selon la revendication 8 dans lequel l'impression commence par l'impression de la moitié inférieure de la première ligne et se termine par l'impression de la moitié supérieure de la dernière ligne.

10. Le procédé selon une revendication précédente quelconque dans lequel les lignes de première et de deuxième couleurs en alternance sont imprimées en un passage de ladite tête d'impression au moins unique transversalement au milieu d'impression.

11. Le procédé selon une revendication précédente quelconque dans lequel les lignes de première et deuxième couleurs en alternance sont imprimées en deux passages de ladite tête d'impression au moins unique.

Fig. 1. (PRIOR ART)

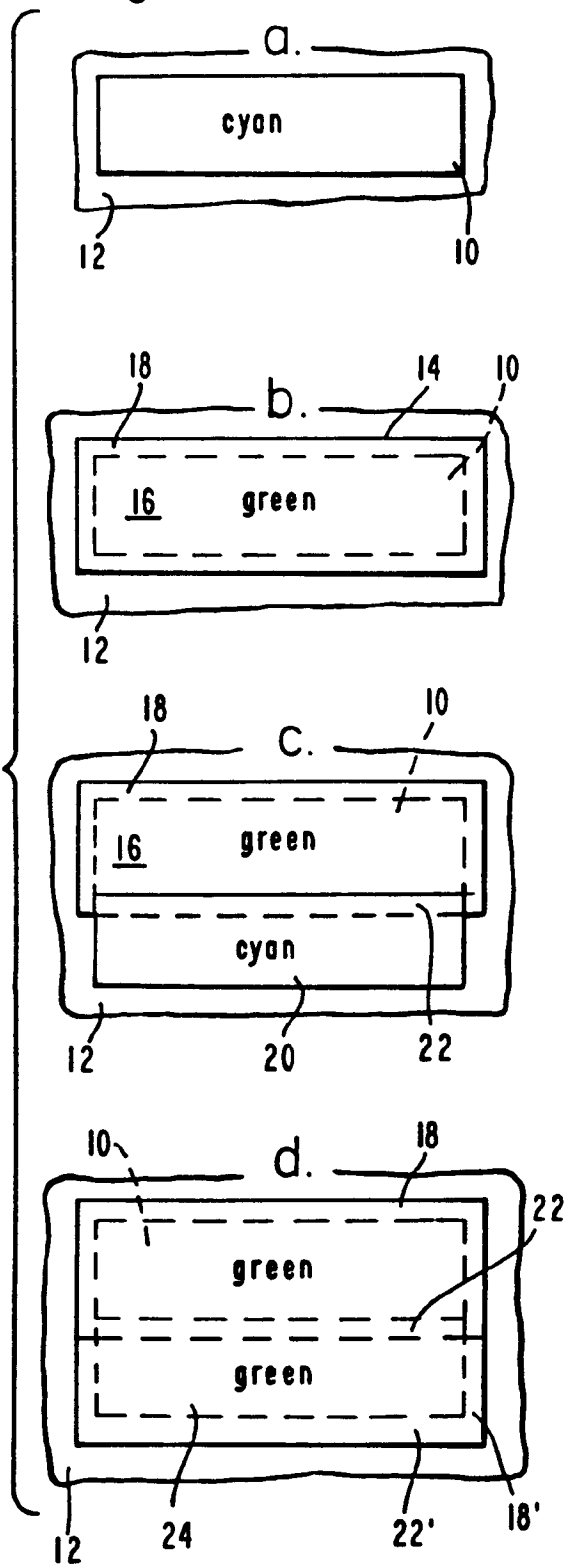


Fig. 2.

