

[54] **METHOD AND APPARATUS FOR PRINTING CODE PATTERNS BY NONIMPACT MEANS**

3,287,734 11/1966 Kazan 346/75
 3,510,878 5/1970 Johnson 346/75
 3,596,285 7/1971 Gottwald 346/75

[75] Inventor: **Eugene Nelson Schroeder**, Bethesda, Md.

Primary Examiner—James W. Moffitt
Assistant Examiner—Jay P. Lucas
Attorney, Agent, or Firm—John G. Wynn

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[22] Filed: **Dec. 27, 1972**

[21] Appl. No.: **318,979**

[57] **ABSTRACT**

[52] U.S. Cl. **346/74.1, 346/75, 346/140**

[51] Int. Cl. **G01d 15/12, G01d 15/18**

[58] Field of Search **346/74 M, 74 MP, 75, 140; 178/6.6 A, 6.6 R; 239/219, 220, 221**

A method and apparatus for printing code patterns, especially magnetic codes, wherein the ink is spun from a rotating disc inside the printer housing through an aperture on the housing and onto the document to be printed. The code pattern is produced by a deflecting means such as electromagnets connected to an electrical signal, the deflecting means preventing or allowing the ink to pass through the aperture in a code pattern.

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

2,763,204 9/1956 Sims 346/140
 2,912,170 11/1959 English et al. 239/219

5 Claims, 8 Drawing Figures

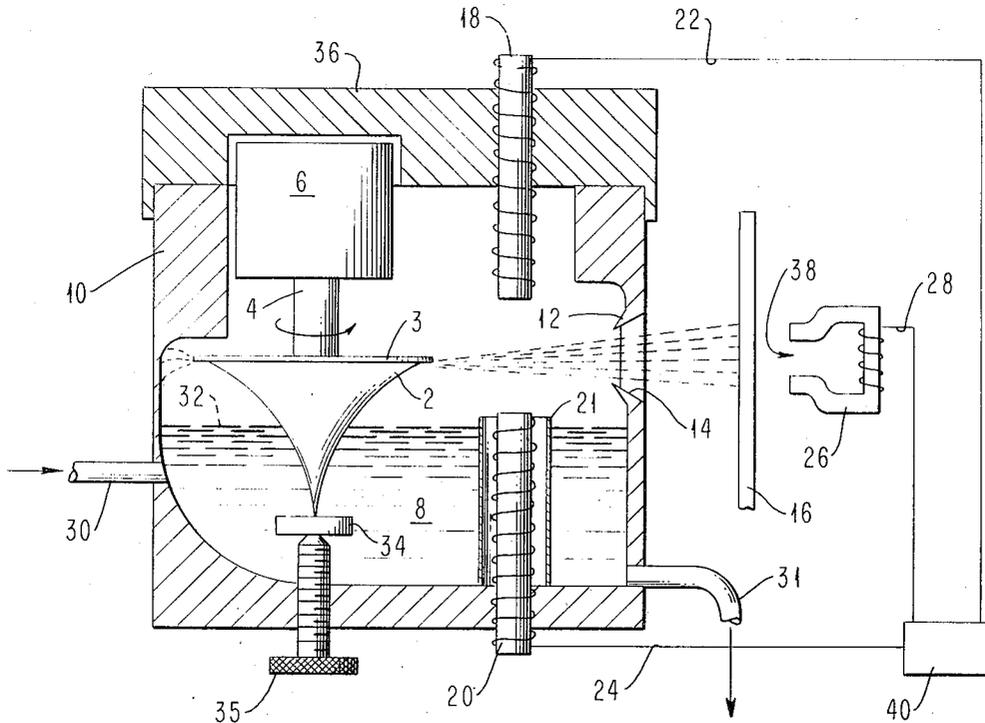


FIG. 1

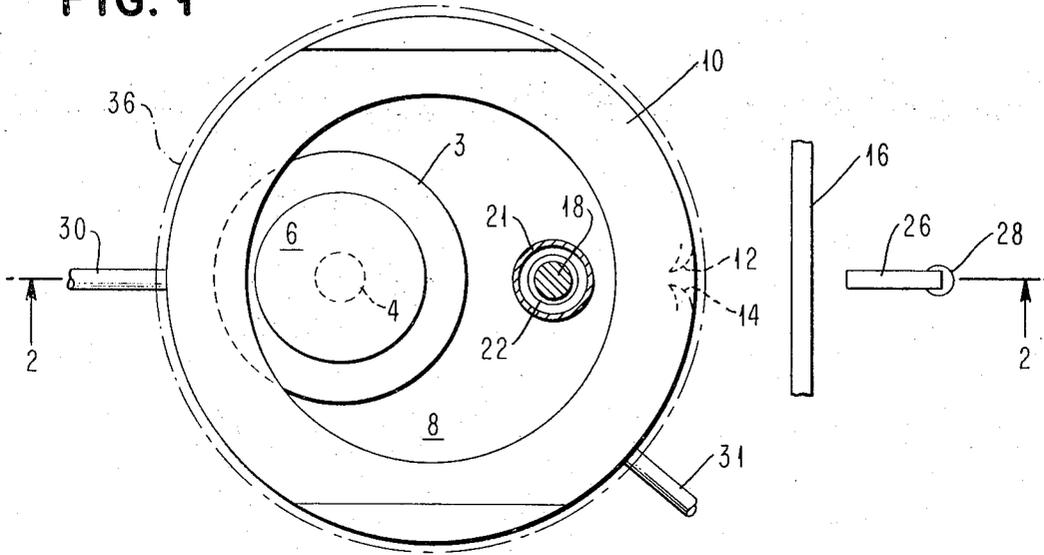


FIG. 2

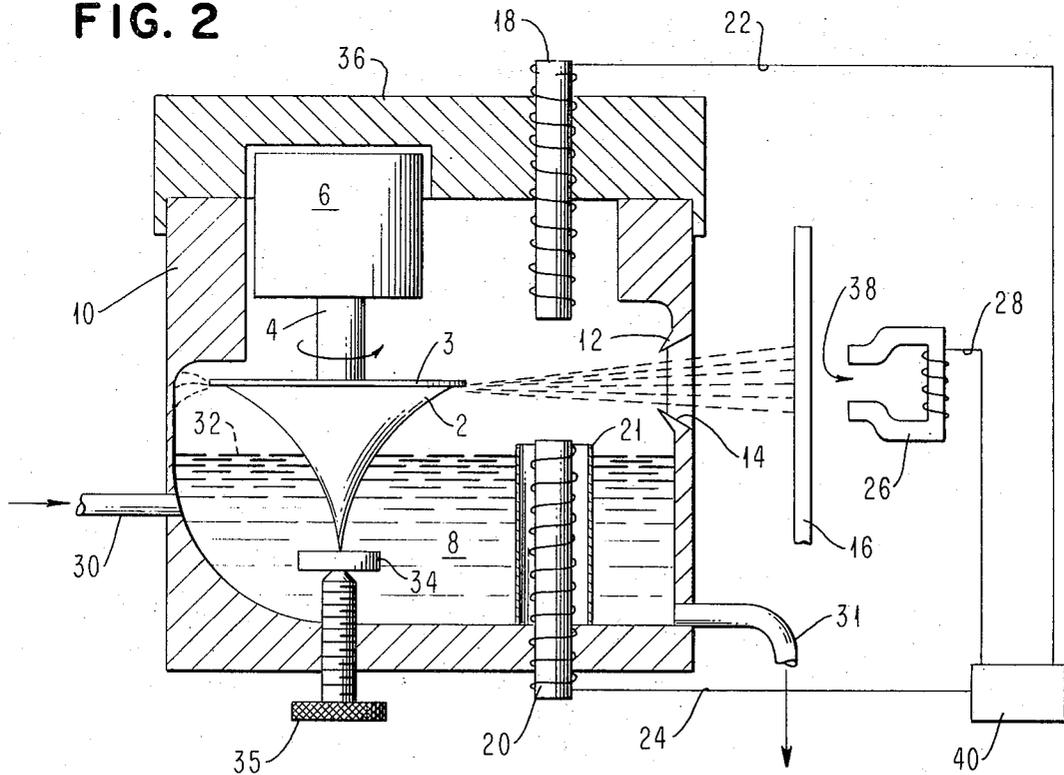


FIG. 3

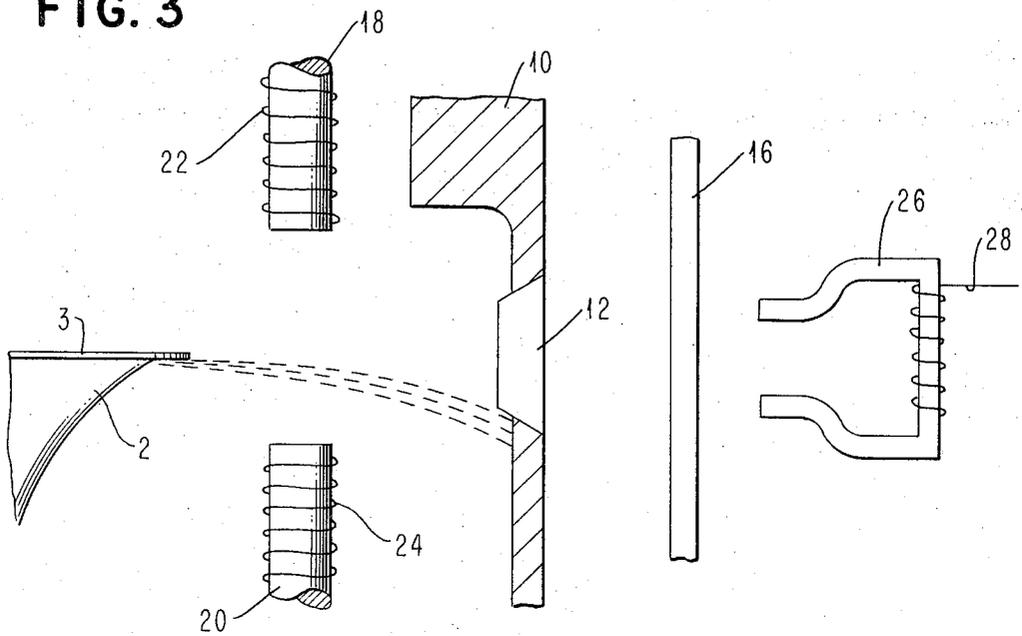


FIG. 4

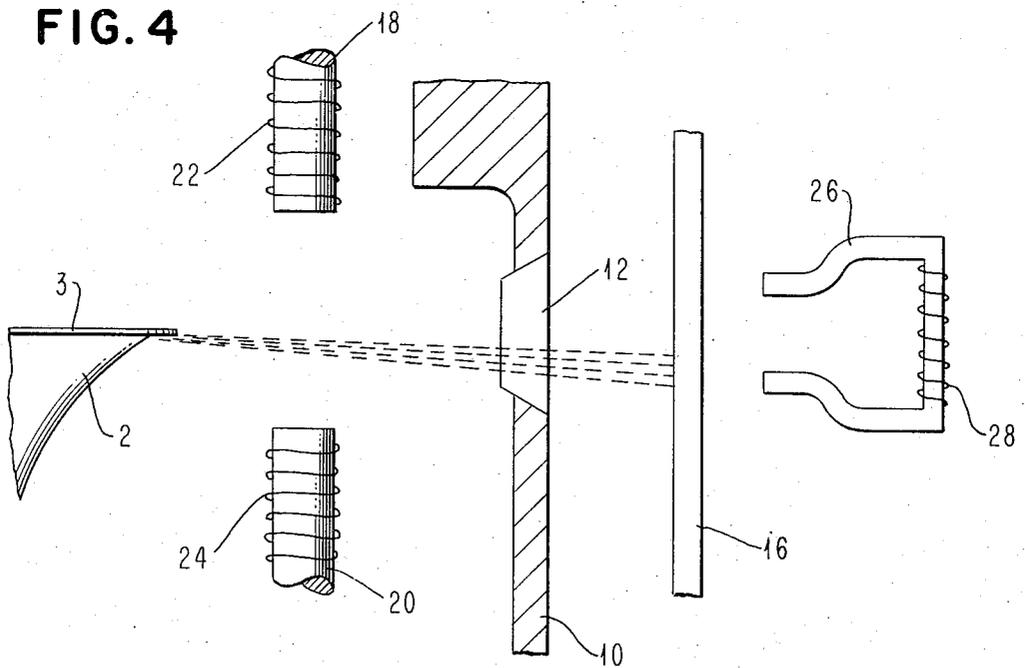


FIG. 5

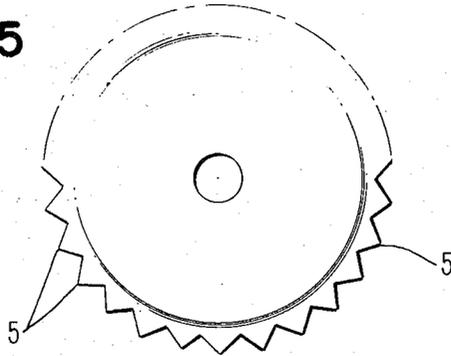


FIG. 6

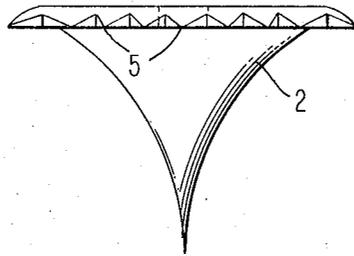


FIG. 7

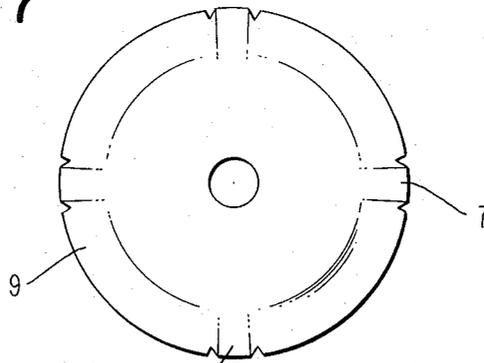
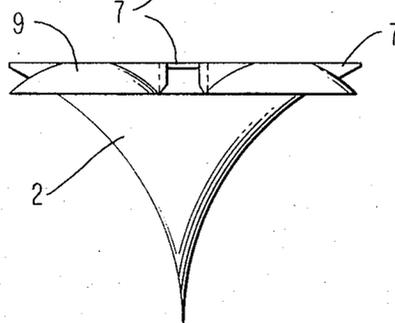


FIG. 8



METHOD AND APPARATUS FOR PRINTING CODE PATTERNS BY NONIMPACT MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to nonimpact printing, and more particularly to code printing of magnetic ink for high speed printers.

2. Prior Art

Various document handling processes require the coding of patterns to permit rapid machine sorting in subsequent operations. Bar codes such as a bar-half bar code or a delta distance code may be used for the subsequent sorting of mail, checks, and other high volume documents.

Because of the large number of documents which require coding for those applications, high speed printers are desired. At the printing speeds required, impact printers are not practical. Present high speed nonimpact printers generally utilize ink droplets ejected from a nozzle having a small orifice, which are electrostatically charged, then accelerated and deflected so as to strike the document in the desired pattern. Such electrostatic nonimpact printers are primarily applicable to the printing of alphanumeric characters. Magnetic inks are generally undesirable for use in such electrostatic printers since they contain relatively large magnetic particles which will abrade and clog the small orifice of the nozzle, causing nonuniform printing and requiring frequent maintenance. The use of conventional inks in such prior art printers, although suitable for the printing of alphanumeric characters are not optimum for code printing. Reading the code from such an ink must be done by optical means which is often difficult due to variations in background reflectivity of different documents as well as problems associated with the mistaken reading by the optical reader of non-code printing on the document.

Printing of bar codes on documents with magnetic ink greatly improves the reading capability, since the document may be read by magnetic as well as optical means. Also, because magnetic deflection rather than electrostatic deflection may be used, the high voltages associated with electrostatic printing can be eliminated.

Finally, another problem associated with the use of non-magnetic inks is that after the ink has been deflected and accelerated towards the document to be printed and as it moves away from the electrostatic field, it is free to diverge and splatter upon impact with the document, often resulting in poor definition, which may cause errors in subsequent reading. Through the use of magnetic inks, the ink may be attracted towards particular areas on the document.

OBJECTS OF THE INVENTION

It is an object of this invention to print code patterns onto documents at high speeds without the recurring problem of nozzle clogging associated with the prior art.

It is another object of this invention to permit the high speed printing of code patterns with inks containing large particles, especially magnetic particles, without nozzle clogging and associate problems related with the prior art.

It is still another object of this invention to provide code printing with better definition which is more eas-

ily readable than the printing obtained from high speed nonimpact printers of the prior art.

SUMMARY OF THE INVENTION

The above objects are accomplished through the use of a spinning disc, rotating at high speeds and projecting ink through an aperture on the printer housing. A code pattern is produced by placing a deflecting means, such as electromagnets, along the ink path between the spinning disc and the aperture to intermittently deflect the ink away from the aperture. Additionally, where magnetic inks are used, another magnet may be placed behind the document to attract the magnetic particles towards a predetermined place on the document after such ink particles leave the aperture of the printer housing.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of the preferred embodiment of the invention, as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a top view of the preferred embodiment of the printer in accordance with this invention.

FIG. 2 is a side view of the printer, taken through line 2-2 of FIG. 1, depicting the printing of a full bar.

FIG. 3 shows full deflection of the ink to produce a space.

FIG. 4 shows the printing of a half bar.

FIG. 5 shows an alternate design of the rotor base surface with a serrated edge where an intermittent projection of ink is desired.

FIG. 6 is an end view of FIG. 5.

FIG. 7 is another alternative of the rotor base surface which provides for a change in the projection path of the ink.

FIG. 8 is an end view of FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2, a rotor 2, shaped as a hyperbolic cone with its base, 3, forming a thin disc or other sharp edge for the upper surface is mounted on a shaft 4 and driven at high speeds by motor 6. The lower portion of the cone is immersed in an ink reservoir 8. On the circumference of the housing, 10, is located a knife edge aperture 12. The aperture is fixed so that all ink striking the knife edge 14 is deflected back into the reservoir while that encountering the open area will pass out of the housing and strike the document 16. For half-bar, full-bar coding, the aperture width and location is chosen so that in the absence of deflection, a substantially square beam of ink is emitted from the lower half of the aperture. Other shapes and locations of the aperture may be used depending upon the type and dimensions of the codes to be printed. For half-bar, full-bar coding, where a binary 1 is represented by a full-bar and a binary 0 is represented by a half-bar, dimensions in the order of 0.110 inches high by 0.106 inches wide are contemplated for full bars while half the height or 0.055 inches high are contemplated for half-bars. Spacings between bars may be equal to the bar width. Thus, for bar codes of this dimension, an aperture of the same size, or slightly smaller size to allow for diversions of the ink after emission from the aperture, may be used. In order to cause

the ink being spun from the rotor base 3 to be projected intermittently through the aperture 12 to the document 16 so as to produce the desired code, a pair of electromagnets 18 and 20 are placed above and below the projected ink. Electromagnet 20 is protected from the ink by casing 21. The electromagnets deflect the ink in such a manner that it will pass through the aperture and print upon the document intermittently in a discernable code. Electromagnets 18 and 20 are activated from a controlled electric signal 40 connected through coils 22 and 24, respectively.

The manner in which electromagnets 18 and 20 deflect the ink so as to produce full-bar, half-bar code upon the document will be more fully explained in the statement of the operation. An additional electromagnet 26, may be positioned behind the document and activated by control signal 40 through coil 28 so as to attract the magnetic particles to a predetermined area of the document.

A supply inlet 30 may be built into the printer to afford a continuous supply of ink, 32. An outlet, 31 may also be provided to remove ink which has been projected towards but then deflected away from the aperture. If it is undesirable to have this ink returned to the reservoir, a separate waste receptacle may be provided.

Since the inks contemplated by this invention may contain large magnetic particles, a stirrer 34 may be mounted on the tip of the rotor to maintain the particles in suspension. Also, a set screw 35 may be placed in contact with the rotor tip to provide a thrust bearing and fine vertical positioner. The top of the housing, 36, may be made easily removable for cleaning and maintenance.

Referring to FIGS. 5 and 6, the disc edge may be serrated so that the ink will be intermittently projected from the rotor. The use of such a design is particularly applicable to bar-no bar codes as more fully described in the statement of the operation. The ink is intermittently emitted from tips 5 at the edge of the rotor base 2.

FIGS. 7 and 8 show another variation of the rotor edge which project the ink towards and away from the aperture without the aid of magnets or additional deflecting means. As the ink is projected out from edges 7, which are higher than edges 9, it moves upward, intermittently printing a bar, as is more fully described in the statement of the operation. The number of sets of edges 7 and 9 on the rotor base will depend upon the spacing of the bars as well as the speed of the rotor and the document.

STATEMENT OF THE OPERATION

Magnetic ink 32 is supplied via inlet 30 to a predetermined level below the rotor base surface 3 of the rotor 4. The level may be adjusted to provide desired print density. The higher the ink level, the thicker will be the spray being projected off the edge of the rotor. However, the ink level must not be raised so high as to cause splattering. As the rotor spins, being driven by high speed motor 6, the ink in the reservoir, into which the lower portion of the cone of the rotor is immersed, is drawn upward to the edge of the rotor base 3. The ink is then emitted from the edge of the base in a generally radial flow and for the most part strikes the housing and is returned to the reservoir. However, at aperture 12 on the housing, the ink may pass through the housing. The aperture is constructed with knife edges 14 so that all

ink striking these edges are deflected back into the reservoir.

Referring to FIG. 3, in normal operation, electromagnet 20 is energized so that all the ink projected toward the aperture is deflected downward, striking the housing and returning to the ink reservoir. By deactivating electromagnet 20 from a control signal through coil 24, the ink will pass through the bottom half of the aperture to print a half-bar code of 0 as shown in FIG. 4. For the printing of a half-bar, electromagnet 20 is intermittently pulsed off and on so that the projected ink upon deactivation of the magnet 20 sweeps up to half the height of the aperture, coding the document with a half-bar, and upon reactivation of the magnet 20 sweeps back down giving document 16 a substantially "double coat." By activation of electromagnet 18 from a control electrical signal through coil 22 at the same time as electromagnet 20 is deactivated, the magnetic ink may be deflected the entire height of the aperture thereby producing a full-bar on document 16 as seen in FIG. 2. Similarly, as electromagnet 18 is deactivated and electromagnet 20 is reactivated, the deflected ink will sweep back down giving substantially a double coat to the document.

By synchronously activating electromagnet 26 through coil 28 upon the deactivation of electromagnet 20, at which time the ink passes through the aperture, the ink is attracted to a predetermined area on the document. By using a double pole magnet with a space 38, ink passing through the lower half of the aperture during the printing of a half-bar will be attracted to the lower pole of the magnet, while ink passing through the upper half of the aperture during the printing of a full bar will be attracted to the upper pole piece.

For other bar codes requiring but one size bar, such as bar-no bar codes and delta distance codes, a single pole piece magnet may be used in place of electromagnet 26, while a single deflecting magnet may be sufficient in place of electromagnets 18 and 20.

For some bar code patterns, such as bar-no bar codes, it may be desirable to modify the edge of the rotor 2 by providing a non-uniform circumference. Such modifications, may be made an integral part of the rotor or may be accomplished by providing for separate parts to be attached to the base of the rotor so a number of code patterns can be obtained from the same printer. In the serrated shaped edge shown in FIGS. 5 and 6, the ink is projected from the rotor 2 in intermittent beams from points 5 rather than in a continuous sheet. In the absence of deflection, a uniform series of bars on a moving document is produced. The number of points, 5, will depend upon the bar spacing, as well as the speed of the rotor and the document. By synchronizing activation of magnet 20 with the rotor position of points 5, individual bars are removed by downward deflection of the selected ink beams away from the aperture as can be generally seen in FIG. 3.

Another rotor edge shape, shown in FIGS. 7 and 8, contains at least one set of emitting surfaces, terminating in edges 7 and 9, one part being angularly displaced from the other. The ink emitted from edge 7 is projected towards the aperture while the ink projected from edge 9 is projected below the aperture. With this configuration, it is unnecessary to constantly activate and deactivate magnet 20 to produce a half-bar pattern. Instead the rotor edge is projecting a uniform series of half-bars. Magnet 20 is only activated to form a

5

6

space where a half-bar would normally be printed while magnet 22 is only activated to form a full bar.

Through the use of a spinning edge projecting ink to a housing aperture, the elimination of nozzles with small orifices, previously required to emit ink at high pressures is accomplished. Through the elimination of the nozzle, inks containing large particles may be used without the problems of clogging or "spitting" of ink from the nozzle. Although the preferred embodiment describes a cone shaped rotor to draw the ink to the spinning edge, it will be appreciated by those of skill in the art that variations such as the ink being fed onto the top surface of the rotor to the edge, or through the edge may be made.

While the invention has been shown and described with reference to preferred embodiments thereof, it will be appreciated by those of skill in the art that variations in form may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A nonimpact printer comprising:

a housing having thereon an aperture for the emission of magnetic ink and containing therein a magnetic ink reservoir;

spinning means for delivering said magnetic ink from said reservoir towards said aperture along a projected path, said spinning means being in the shape of a cone with the tip of said cone pointing downward and immersed into said reservoir and the base of said cone terminating into a thin edge positioned above said reservoir and in substantially the same horizontal plane as said aperture, to prevent clogging of said printer by magnetic particles in said magnetic ink; and

deflecting means along said magnetic ink projection path from said spinning means to said aperture to intermittently deflect said magnetic ink away from said aperture so that a document to be printed, passing adjacent to said aperture, is printed with a discernable code, said deflecting means being elec-

tromagnets controlled by electrical signals so that said magnetic ink is deflected according to said electrical signals, thereby printing said discernable code.

2. The printer of claim 1 further including a magnet placed outside of said housing and behind said document to be printed to attract said magnetic ink to the proper area on said document.

3. The printer of claim 1 wherein the periphery of said base of said cone contains a plurality of serrations to provide an intermittent spray of said magnetic ink.

4. The printer of claim 3 wherein said serrations on said base of said cone contains at least one set of emitting surfaces, said surfaces being angularly displaced from each other so that said magnetic ink being projected from the edge of said surfaces is displaced in a vertical direction.

5. A process for printing a bar-half bar code pattern onto a document comprising the steps of:

spinning a magnetic ink to project said magnetic ink towards an aperture on a printer housing;

deflecting said magnetic ink away from said aperture by activating a first magnet along the path of said magnetic ink projection between said spinning means and said aperture so that a space is produced on said document passing adjacent to said aperture by intermittently preventing said magnetic ink from impinging on said document;

projecting said magnetic ink through half height of said aperture by deactivating said first magnet and then reactivating said first magnet so that a half-bar is printed on said document; and

projecting said magnetic ink through the entire height of said aperture by deactivating said first magnet while activating a second magnet adjacent thereto on the opposite of said path of said magnetic ink projection and then activating said first magnet while deactivating said second magnet so that a full bar is printed on said document.

* * * * *

45

50

55

60

65