

[54] **INK SPRAY PRINTER**
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 [73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.
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 [21] Appl. No.: **335,863**

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[52] **U.S. Cl.**..... 101/114, 101/129, 197/48, 118/301, 117/38, 346/75
 [51] **Int. Cl.**..... **B411 13/00**
 [58] **Field of Search** 197/18, 48; 101/112, 114, 101/116, 122, 127, 129, DIG. 13, 48; 118/301; 346/75, 107 A, 1 R; 117/38

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Assistant Examiner—E. H. Eickholt

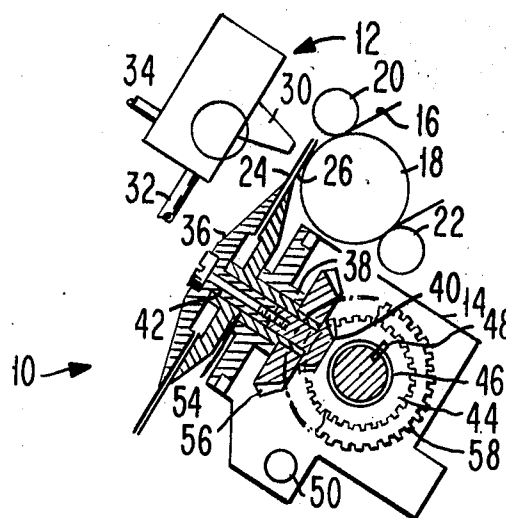
Attorney, Agent, or Firm—Francis V. Giolma

[57]

ABSTRACT

Printing on a document is done by moving a rotating shutter having a narrow slit, between the document and a rotating stencil having character apertures, and moving both past a print position in timed relation with an ink spray from a nozzle supplied with ink and air under pressure.

1 Claim, 12 Drawing Figures



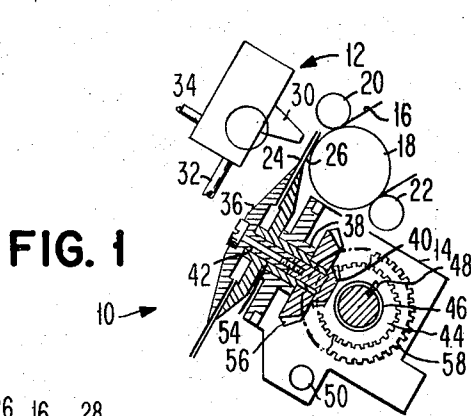


FIG. 1

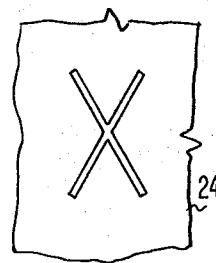


FIG. 2

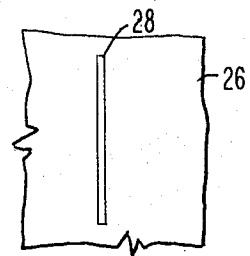


FIG. 3

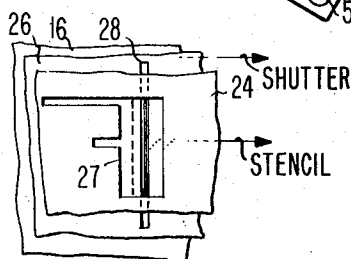


FIG. 4a

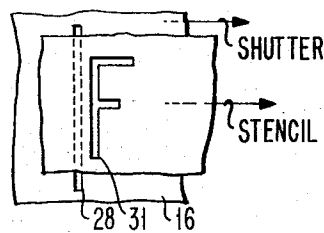


FIG. 5a

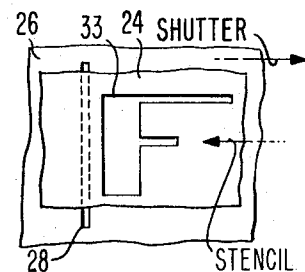


FIG. 6a

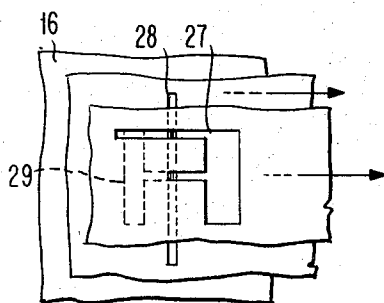


FIG. 4b

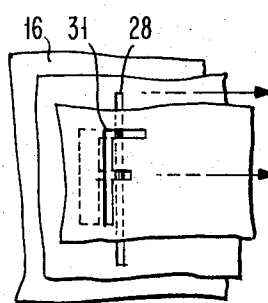


FIG. 5b

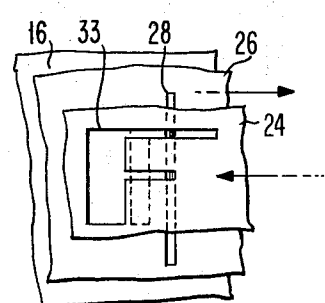


FIG. 6b

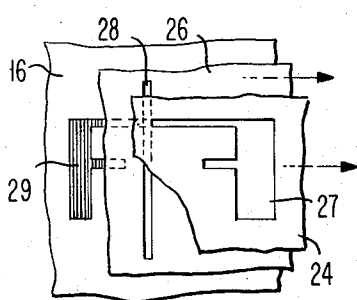


FIG. 4c

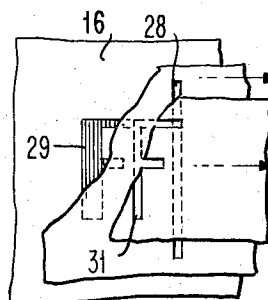


FIG. 5c

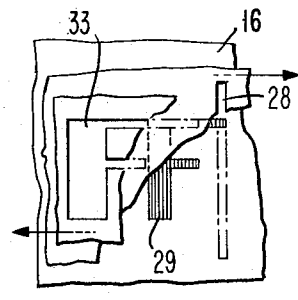


FIG. 6c

INK SPRAY PRINTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to printers and it has reference in particular to ink jet printing using a character bearing stencil and a shutter through which the ink passes to form characters on a document.

2. Description of the Prior Art

Ink jet printers are known such as disclosed in U.S. Pat. No. 3,416,153, entitled Ink Jet Recorder, which issued to C. H. Hertz et al. on Dec. 10, 1968, and it discloses an electrode spaced from an ink nozzle for dispersing the spray and preventing the spray from passing through a shield to impinge on a document. U.S. Pat. No. 3,621,967, entitled Liquid Emission Typewriter issued to Irving I. Brown on Nov. 23, 1971 and discloses printing on a document by means of an ink nozzle and a character bearing disc.

SUMMARY OF THE INVENTION

Generally stated it is an object of the invention to provide an improved ink jet printer.

More specifically it is an object of this invention to provide for interposing a shutter between a character bearing mask or stencil and a document upon which printing is to be performed by a spray of ink.

Another object of the invention is to provide for printing with a controllable ink spray by utilizing a character bearing stencil and a shutter having a narrow slit moving past an ink nozzle at different speeds.

Yet another object of the invention is to provide for moving a shutter having a narrow slit, through the space between a character bearing stencil and a document upon which it is desired to print with a spray of ink under pressure from a nozzle.

It is also an object of the invention to provide for moving a shutter having a narrow slit, in a space between a document and a moving stencil carrying character apertures with the stencil moving in the same direction but faster than the shutter.

Another important object of the invention is to provide for printing with an ink spray through a character bearing stencil moving past a print position on a document, by having a shutter with a narrow slit moving in the same direction but faster than the stencil.

It is also an important object of the invention to provide for printing by means of an ink spray through a moving character bearing stencil, by having a shutter with a narrow slit move between the stencil and a document, but in the opposite direction.

One other object of the invention is to provide for printing on a document by means of an ink spray by using a rotating stencil having character apertures and utilizing a rotating shutter positioned between the stencil and the document having a narrow slit therein.

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

DESCRIPTION OF THE DRAWING

In the drawing

FIG. 1 is a schematic partial view in vertical cross-section of printing apparatus using the invention in one of its forms;

FIGS. 2 and 3 are enlarged partial views of the stencil and shutter of FIG. 1 showing a typical character aperture and the slit, respectively.

FIGS. 4a, 4b and 4c are enlarged partial views broken out in part of the stencil, shutter and document showing different steps in printing with the stencil and shutter moving in the same direction, the stencil moving faster than the shutter.

FIGS. 5a, 5b and 5c show similar views with the shutter moving faster than the stencil; and

FIGS. 6a, 6b and 6c show similar views with the stencil and the shutter moving in opposite directions.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1 the reference numeral 10 denotes generally a print head carrier mechanism utilizing an ink jet nozzle structure 12 mounted on a carrier 14 for movement along a print line on a document 16 positioned about a platen 18. Feed rolls 20 and 22 are provided for feeding the document past the ink nozzle structure 12. In order to provide for printing characters on the document 16 a stencil 24 having a plurality of character apertures adjacent the periphery, as represented by aperture 25 defining the character x in FIG. 2 is moved past the ink jet nozzle structure. At the same time a shutter 26 positioned between the stencil and the document 16, is moved relative to the stencil 24 and is provided with a narrow slit 28 as shown in FIG. 3.

The nozzle structure 12 may be similar to that described in either of the Hertz et al or Brown patents hereinbefore referred to. It may also comprise an air brush type nozzle having an ink nozzle 30 to which ink may be supplied through a conduit 32 in conjunction with air under pressure through a conduit 34. The air may be controlled by means of a solenoid operated valve and an emitter (not shown) which is connected in driven relation with the stencil to provide a spray of ink in timed relation with the passage of the character apertures past the nozzle 30 in a manner well known in the art.

As shown in FIG. 1 the character bearing stencil 24 may comprise a relatively thin disc mounted on a hub 36 and supported on the carrier 14 by means of a bearing 38. A bevel gear 40 is connected to the hub by means of a shaft 42 and is engaged by teeth 44 of a corresponding bevel gear mounted on a carrier drive shaft 46 so as to be slidable thereon but keyed thereto by means of a key 48 to rotate with the carrier shaft. The carrier 14 is supported on the carrier shaft 46 and a parallel guide shaft 50 for motion along the print line.

The shutter 26 is likewise mounted on a hub 52 carried by a tubular shaft 54 concentric with the shaft 42 which passes therethrough. A gear 56 is mounted on the other end of the shaft 54 for engagement with teeth 58 of the gear mounted on the carrier shaft 46. Rotation of the carrier shaft 46 rotates the gear teeth 58 and 44 driving the gears 56 and 40 in predetermined relation so that the shutter 26 and stencil 24 rotate, for example, in the same direction but at different speeds.

Referring to FIGS. 4a, 4b and 4c it will be seen that relative motions of the stencil 24 and shutter 26 are such that when a given character aperture 27 on the stencil 24, representing the letter F, in reverse, sweeps past a print position on the document, simultaneously the narrow slit 28 on the shutter 26 would also sweep past the same print position but at a different speed.

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The result is that the shutter 26 continuously exposes different portions of the character aperture or cutout 27. If the ink spray is turned on just before the arrival of the character cutout 27 and the narrow slit 28 combination, the ink spray will sweep through different portions of the character cutout 27 and print out in time the whole character F on the paper as shown by the shaded outline 29. In this particular example the stencil 24 is moving faster than the shutter 26. A ratio of 2 to 1 in the speeds of the stencil and shutter has been found to be quite satisfactory.

Referring to FIGS. 5a, 5b and 5c a typical arrangement is shown for the shutter with a slit 28 and stencil with a character aperture 31 representing the letter F, combination with the shutter 26 moving faster than the stencil 24. FIGS. 6a, 6b and 6c illustrate similar stages in the printing of the character F with the stencil and shutter 24 having a character aperture 33 representing the character F travelling in opposite directions.

While the implementation of the invention has been shown in connection with rotating shutter and stencil constructions, the stencil and shutter may be in the form of a tape, each driven at different speeds. Alternatively both the stencil and shutter may be of discs of either equal or different diameters and rotating at either different or the same angular velocities. Both the shapes of the character cutouts on the stencil and the widths of the slits on the shutter should be designed in accordance with the relative motions of the stencil, shutter and paper and the ink spray velocity. For example, in FIGS. 4a, 4b and 4c the width of the vertical legs of the character aperture 27 is on the order of double the width of the desired character and the aperture 27 is reversed, left to right. The stencil 24 was rotated at 10 rpm and the shutter 26 at 5 rpm. With reference to FIGS. 5a, 5b and 5c the width of the vertical section of the character aperture 31 in the stencil is on the order of one-half the width of the actual character 29. In this instance the shutter was rotated at 20 rpm and the stencil at 10 rpm. In the illustration shown in FIGS. 6a, 6b and 6c the width of the vertical leg of the character aperture 33 in the stencil 26 is on the order of double the width of the desired printed character 29. The stencil 24 and shutter 26 travel in opposite directions the stencil and shutter both operating at about 10 rpm.

In one embodiment the shutter and stencil were approximately 4 inches in diameter and are made of a material non-wettable by the ink. A vinyl-like plastic such as Mylar or a stainless steel may be used. The stencil 24 may be thick enough to be fairly rigid on the order of 15 mils while the shutter 26 may be relatively thin on the order of 3 to 5 mils thick and provided with a 6 to

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10 mil wide slit. With the stencil 24 moving faster than the shutter 26 a slit 28 may be provided for each character about the periphery, whereas when the shutter moves faster than the stencil fewer slits may be required, only half as many slits as characters being necessary when the shutter moves twice as fast as the stencil. Air at a pressure of 30 to 50 lbs was used successfully with the ink itself being supplied at near zero pressure.

For serial printer applications both the stencil and shutter may be in the disc form, mounted on a moving carriage as shown. Printing may take place either at the 12 o'clock position or the 9 o'clock position of the rotating discs. Since the carriage is in continuous motion from left to right while printing the character cutouts in each case must be positioned on the stencil disc so as to compensate for this motion. In the particular case where the printing takes place at the 9 o'clock position the character cutouts must be positioned along a helical spiral on the disc and in fact the character cutouts may be spaced over a helical spiral of several revolutions which together with a multiple print station may result in an increase of the print rate without increasing the speed of the printing operation itself.

While the invention has been shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. In character printing apparatus:

a nozzle having fluid ink supplied thereto under pressure to provide a spray of fluid ink directed at a document,

a stencil positioned between the nozzle and the document having a plurality of spaced apart character forming openings therein, said stencil being movably mounted so as to continuously move said openings between said nozzle and a position on said document where a character is to be printed, a shutter movably positioned between said stencil and said document and having a narrow slit therein, said shutter being positioned to continuously move said slit between said nozzle and said print position and relative to said character openings, and

drive means connected to said stencil and said shutter to move said stencil past said print position in one direction and said shutter past said print position in the opposite direction at different speeds.

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