(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 997 301 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.05.2000 Bulletin 2000/18

(51) Int. Cl.[7]: **B41J 11/00**

(21) Application number: **99308175.1**

(22) Date of filing: **18.10.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **30.10.1998 US 182788**

(71) Applicant: **Xerox Corporation**
Rochester, New York 14644 (US)

(72) Inventors:
- **Barner, Jeffrey D.**
  Rochester, New York 14618 (US)
- **Szlucha, Thomas F.**
  Fairport, New York 14450 (US)
- **Peter, Kenneth C.**
  Penfield, New York 14526 (US)

(74) Representative:
W.P. Thompson & Co.
Coopers Building,
Church Street
Liverpool L1 3AB (GB)

(54) Infrared foil heater for drying ink jet images on a recording medium

(57) A heater (50) is disposed in a post-print location of an ink printer (10) to provide a post-print drying of an ink image formed on a recording medium (16). The heater (50) includes a foil circuit (52) made of a material which, when receiving an applied power from a power source (56), emits radiation in the infrared range. The heater (50) is located above the paper path and presents a rapid uniform application of IR radiation to predetermined areas of the recorded image resulting in fast, efficient drying of the image and enabling a high productivity printer.

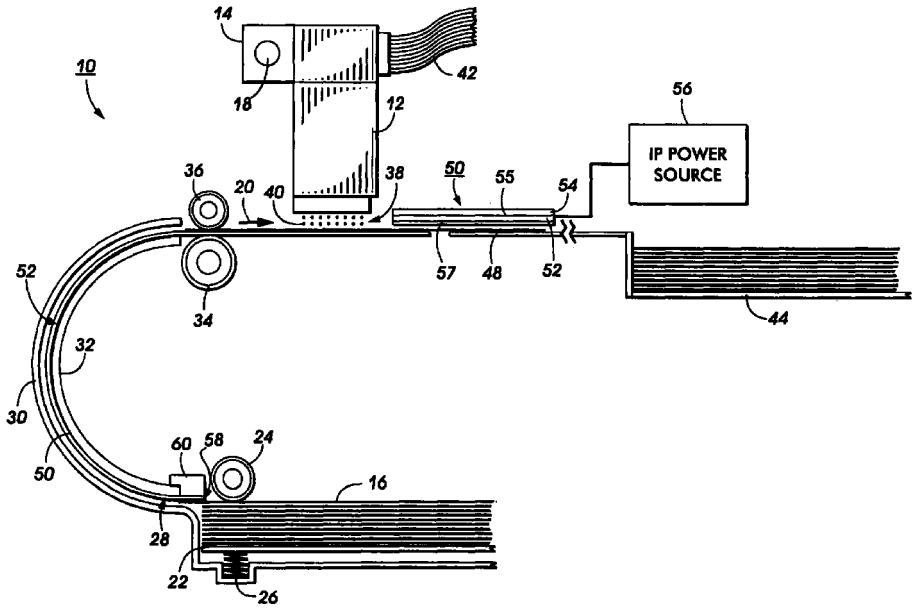

FIG. 1

EP 0 997 301 A2

Description

[0001] The invention relates generally to a liquid ink printer and, more particularly, to an infrared foil heater which is used to dry images previously formed on a recording medium.

[0002] Liquid ink printers of the type frequently referred to as continuous stream or as drop-on-demand, such as piezoelectric, acoustic, phase change wax-based or thermal, have at least one printhead from which droplets of ink are directed towards a recording medium. Within the printhead, the ink is contained in a plurality of channels. Power pulses cause the droplets of ink to be expelled as required from orifices or nozzles at the end of the channels.

[0003] In a thermal ink-jet printer, the power pulse is usually produced by a heater transducer or a resistor, typically associated with one of the channels. Each resistor is individually addressable to heat and vaporize ink in the channels. As voltage is applied across a selected resistor, a vapor bubble grows in the associated channel and initially bulges from the channel orifice followed by collapse of the bubble. The ink within the channel then retracts and separates from the bulging ink thereby forming a droplet moving in a direction away from the channel orifice and towards the recording medium whereupon hitting the recording medium a dot or spot of ink is deposited. The channel is then refilled by capillary action, which, in turn, draws ink from a supply container of liquid ink.

[0004] The ink jet printhead is typically incorporated into a carriage type printer which has a relatively small printhead containing the ink channels and nozzles. The printhead can be sealingly attached to a disposable ink supply cartridge. The combined printhead and cartridge assembly is attached to a carriage which is reciprocated to print one swath of information (equal to the length of a column of nozzles), at a time, on a stationary recording medium, such as paper or a transparency. After the swath is printed, the paper is stepped a distance equal to the height of the printed swath or a portion thereof, so that the next printed swath is contiguous or overlapping therewith. This procedure is repeated until the entire page is printed.

[0005] Many liquid inks and particularly those used in thermal ink jet printing, include a colorant or dye and a liquid which is typically an aqueous liquid vehicle, such as water, and/or a low vapor pressure solvent. The ink is deposited on the substrate to form an image in the form of text and/or graphics. Once deposited, the liquid component is removed from the ink and the paper to fix the colorant to the substrate by either natural air drying or by active drying. In natural air drying, the liquid component of the ink deposited on the substrate is allowed to evaporate and to penetrate into the substrate naturally without mechanical assistance. In active drying, the recording medium is exposed to heat energy of various types which can include infrared heating, conductive heating and heating by microwave energy.

[0006] Active drying of the image can occur either during the imaging process or after the image has been made on the recording medium. In addition, the recording medium can be preheated before an image has been made to precondition the recording medium in preparation for the deposition of ink. U.S. Patent No. 5,742,315 discloses a segmented flexible heater which produces both pre-print heating and heating during the print, or recording, process.

[0007] Various other drying mechanisms for drying images deposited on recording mediums are illustrated and described in the following disclosures.

[0008] In U.S. Patent No. 4,982,207, to Tunmore et al., a heater construction for an ink jet printer having a rotary print platen for holding and transporting a print sheet through a print path is described. The platen heater includes a hollow shell having vacuum holes for sheet attachment. A heating foil is detachably mounted in a heat transfer relation with the interior periphery of the shell.

[0009] U.S. Patent No. 5,005,025, to Miyakawa et al., describes an ink jet recording apparatus for recording which fixes ink through evaporation of an ink solvent. The apparatus includes a heating member extending both upstream and downstream with respect to a recording area and a conveying direction of the recording sheet. The heating member contacts the recording sheet to assist in the fixation of the ink.

[0010] These prior art heating devices become less optimum as productivity requirements and print speeds increase. Slow to medium drying inks are currently used in most ink products and printers to provide for optimum print quality for black to achieve performance comparable to xerographic toner images. These slow to medium inks typically take 45-60 seconds to dry at ambient environment without a dryer assist. Dry times over a wide variety of media in stress environments can be driven under 5 seconds with the use of a dryer assist. In the commercial Hewlett Packard 1200/1600C printer, for example, dryer assist is provided with a tungsten-halogen lamp and reflector disposed in the post-print zone. This arrangement is effective at speeds of less than 10 prints per minute (ppm) but becomes less effective at speeds greater than 10 ppm. As a further drawback, with prior art/reflector arrangements, efficiency declines as the drying zone length increases. Also, "hot spots" can occur with a lamp/reflector design.

[0011] All the above-identified prior art references are hereby incorporated by reference.

[0012] In accordance with one aspect of the present invention, there is provided a liquid ink printer for printing on a recording medium moving along a path through a print zone. The printer includes a printhead which deposits ink on a recording medium as it is moved through the print zone. According to the invention, a foil heater is disposed in a location downstream from the print zone. The heater is an infrared emitting, etched foil

circuit heater which produces a very uniform power distribution because the heater circuit foil area can be tailored to match a desired drying zone exposure. Further, the heater provides an improvement over the lamp/reflector heater design due to its compact size, low cost, high reliability and fast, warm characteristics.

[0013] More particularly, the present invention relates to a printer for printing on a recording medium moving through at least a print zone and a post-print zone, comprising:

a printhead which deposits ink onto the recording medium in a predetermined pattern,
a foil heater disposed in said post-print zone in a non-contact position above the recording medium moving therebeneath, said heater including a foil heater circuit having a length and width selected to match a predetermined area of a recorded image,
a power source for providing current to said foil heater to generate a radiation output in the infrared range and
whereby a uniform radiation is applied to said predetermined area of the recorded image.

[0014] An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a schematic elevational side view of an ink jet printer which incorporates a post-print infrared foil heater of the present invention; and
FIG. 2 shows a bottom view of the infrared foil heater of FIG. 1.

[0015] Although the present invention discussed herein may be used for drying any image which is created by a liquid ink printer, the description of the present invention will be described in the environment of an ink jet printer such as that shown in FIG. 1. FIG. 1 illustrates a schematic representation of a thermal ink jet printer 10 in a side elevation view. A translating ink jet printhead 12 printing black and/or colored inks is supported by a carriage 14 which moves back and forth across a recording medium 16, for instance, sheets of paper or transparencies, on a guide rail 18. Multiple printheads printing different colors are also within the scope of this invention. The recording medium 16 is moved along a recording medium path through the printer in the direction noted by the arrow 20. Single sheets of the recording medium 16 are fed from a fray 22 by a document feed roll 24. The document tray 22 is spring biased by a biasing mechanism 26 which forces the top sheet of the stack of recording sheets held by the tray 22 into contact with the feed roll 24. A top recording medium 16 in contact with the drive roll 24 is transported by the drive roll 24 into a chute 28 which is defined by an outer guide member 30 spaced from an inner guide member 32, each of which are curved to thereby reverse the direction of the recording sheets 16 for printing by the printhead 12. Once the recording medium exits the chute 28, the recording medium 16 is driven into the nip of a drive roll 34 cooperating with a pinch roll 36 to advance the recording sheet 16 into a print zone 38.

[0016] The print zone 38 is the area directly beneath the printhead 12 where droplets of ink 40 are deposited by an array of ink nozzles printing a swath of information and arranged on a front face of the printhead. The front face of the printhead is substantially parallel to the recording medium. The carriage 14, travelling orthogonally to the recording medium 16, deposits the ink droplets 40 upon the recording medium 16 in an imagewise fashion. The printhead 12 receives ink from either an attached ink tank or from an ink supply tube (not shown). The image deposited upon the recording medium 16 can include text and/or graphic images, the creation of which is controlled by a controller, known to those skilled in the art, in response to electrical signals travelling through a ribbon cable 42 coupled to the printhead 12. Before the recording medium 16 has completely left control of the drive roll 34 and the pinch roll 36, an exit drive roll/pinch roll combination (not shown) or other known means captures the leading edge of the recording medium 16 for transport to a platen 48 underlying an IR heater assembly 50 and, thence, to an output tray 44 which holds the printed recording medium.

[0017] Heater assembly 50, in a preferred embodiment, consists of an etched foil heater circuit 52 (shown in bottom view in FIG. 2) mounted to a ceramic insulator 54 and reinforced with a fiberglass mounting mesh with adhesive. A voltage is applied to IR power heater 50 by IR power source 56 which, in a preferred embodiment, is 120 VAC. The dimensions of the circuit 52 can be selected to provide a uniform power distribution which is matched to the particular drying zone exposure. In other words, circuit 52 dimensions x, y can be tailored to match a particular drying exposure zone x, y and specifically can provide active drying zones of greater than three inches. In one example, the voltage applied to circuit 52 generates a current between 6.5 and 7.0 amps and the heat energy produced approximately 22 watts per square inch. Circuit 52 is made of Chromium Aluminum and Iron Alloy which heats to a color temperature of approximately 400-600 °C by the applied power. Circuit 52 has a thickness of approximately .05". Insulator 54 has a thickness of approximately .95" for a total combined thickness for heater 50 of 1". A sheet 16 moves through the print zone at a process speed of 2 inches per second. Heater 50 is spaced a distance of approximately 0.6 inches above the paper path. The print will be dried in 2 to 7 seconds before reaching the output tray depending on paper type and amount of ink on paper being dried.

[0018] In summary, there has been described an IR foil heater for rapid drying of an ink image previously formed on a recording medium moving along a paper

path. The heater is disposed above the paper path at a post-print location. The foil heater circuit has an area matching the desired active drying zone and provides a uniform band of IR radiant heat to the deposited image drying the image in a fraction of the time required by prior art devices.

[0019] While the invention has been described in conjunction with a specific embodiment thereof, it is evident that many alterations, modifications and variations will be apparent to those skilled in the art. For example, while Chromium Aluminum and Iron Alloy is the preferred medium for heating to produce IR radiation, other conductive materials such as Nickel Chromium Alloy and Nickel Chromium and Iron Alloy may be used. While 22 watts/sq. in. were given as an optimum heating density, it has been found that radiation within a range of 10 to 30 watts/sq. in. will provide rapid drying time depending on paper condition and the amount of ink present. Accordingly, the invention is intended to embrace all such alterations, modifications and variations that fall within the specific and broad scope of the following claims.

Claims

1. A printer (10) for printing on a recording medium (16) moving through at least a print zone (38) and a post-print zone, comprising:

   a printhead (12) which deposits ink onto the recording medium (16) in a predetermined pattern,
   a heater (50) disposed in said post-print zone in a non-contact position above the recording medium moving therebeneath, said heater including a foil heater circuit (52) having a length and width selected to match a predetermined area of a recorded image,
   a power source (56) for providing current to said foil heater (50) to generate a radiation output in the infrared range and
   whereby a uniform radiation is applied to said predetermined area of the recorded image.

2. The printer of claim 1, wherein said radiation output is within a range of 10 to 30 watts/sq. in.

3. The printer of claim 1 or 2, wherein said heater comprises a foil heater circuit (52) bonded to a ceramic substrate (54), the heater having a combined thickness of between .2 and 1.2 inch.

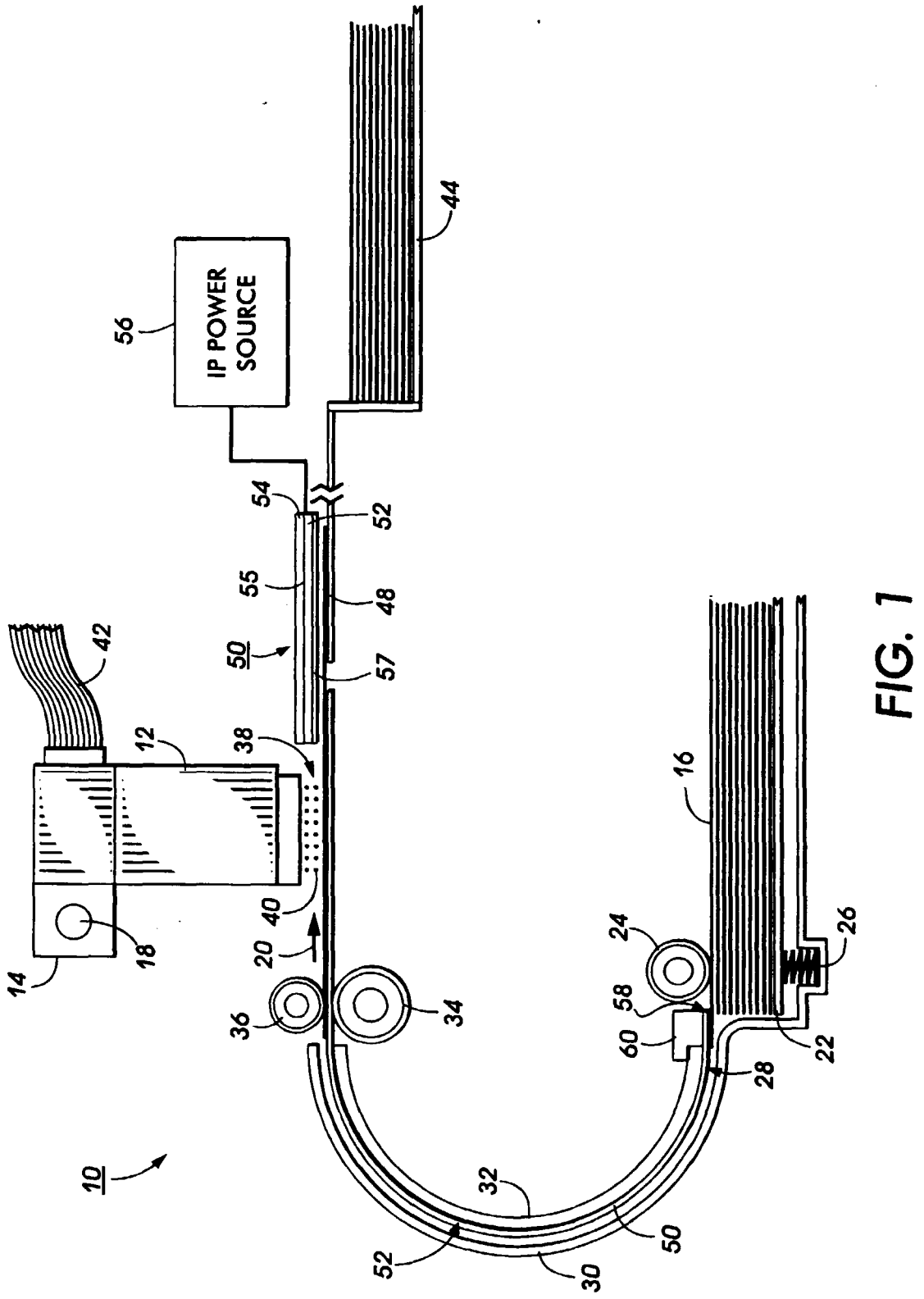
IP POWER SOURCE
56
44
54
52
55
48
50
57
42
12
38
16
40
20
24
26
58
60
22
28
14
18
36
34
10
32
50
52
30

FIG. 1

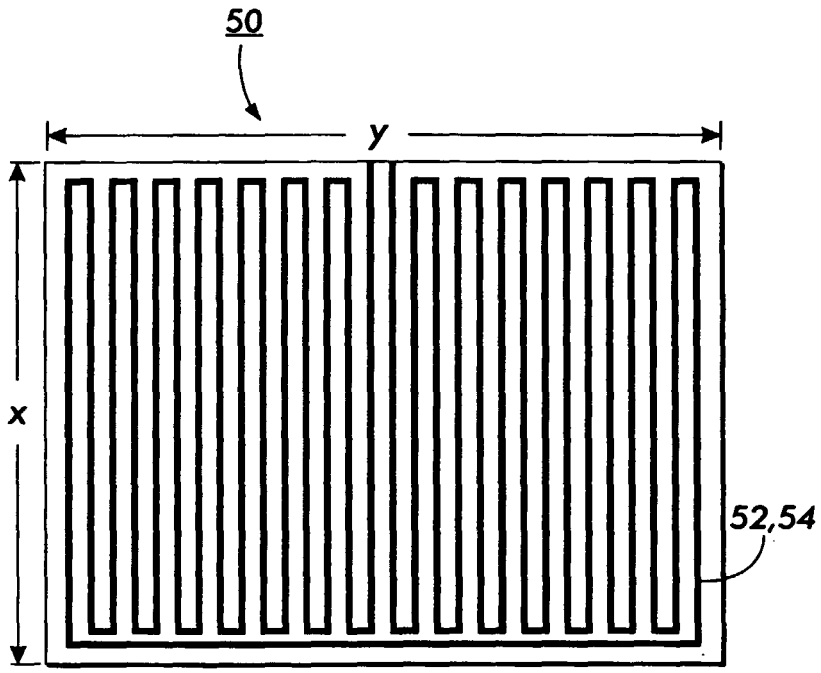

FIG. 2