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

(11) EP 0 764 525 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.03.1997 Bulletin 1997/13

(51) Int Cl.[6]: **B41J 2/01**, B05D 1/00, A61M 35/00

(21) Application number: **96306774.9**

(22) Date of filing: **18.09.1996**

(84) Designated Contracting States:
DE FR GB

(30) Priority: **19.09.1995 US 530749**

(71) Applicant: **SCITEX DIGITAL PRINTING, Inc.**
Dayton, Ohio 45420-4099 (US)

(72) Inventors:
- **Fagerquist, Randy L.**
Union, Ohio 45322 (US)
- **Bahl, Surinder K.**
Beavercreek, Ohio 45434 (US)

(74) Representative: **Hillier, Peter et al**
Reginald W. Barker & Co.,
Chancery House,
53-64, Chancery Lane
London, WC2A 1QU (GB)

(54) Continuous flow ink jet-type general purpose surface coating applicator

(57) A coating applicator method is used to apply a coating substance to an ink jet printer substrate. The method comprises the steps of dissolving a coating substance in a carrier fluid to create a coating product. The coating product is applied as a controllable pattern of discrete droplets onto the substrate. This produces a uniform, controllable surface coating on the ink jet printer substrate, the surface coating typically being a liquid solution.

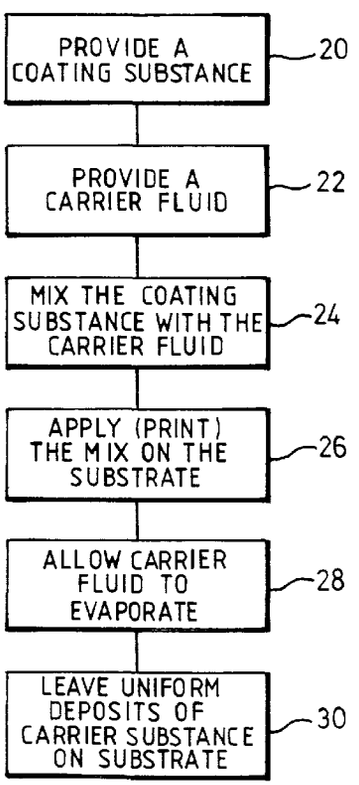


FIG. 2

EP 0 764 525 A2

Description

Technical Field

The present invention relates to continuous ink jet printers and, more particularly, to a surface coating applicator for printing with such printers.

Background Art

In continuous ink jet printing, electrically conductive ink is supplied under pressure to a manifold region that distributes the ink to a plurality of orifices, typically arranged in a linear array(s). The ink discharges from the orifices in filaments which break into droplet streams. Individual droplet streams are selectively charged to substantially two levels in the region of the break off from the filaments and charged drops are deflected from their normal trajectories. Either the deflected drops or the undeflected drops are caught and recirculated, and the other drops are allowed to proceed to a print medium.

In some situations, it is desirable to provide a substrate with a surface coating having a very uniform surface density. This technique can also be used to make intentionally non-uniform surface coatings or those with intricate designs. The prior art is replete with procedures for producing surface coatings. Unfortunately, existing procedures for producing surface coatings involve a contact technique, wherein a fine powder or emulsion is spread onto a surface, or a spraying procedure using droplets is applied having a somewhat random distribution of volumes and impact trajectories. Contact surface coating processes are typically slow, compared with the speed of current ink jet printing systems, and the reproducibility of some techniques will depend on the distribution of particle sizes used. It is also difficult to distribute the particles evenly over broad surfaces and over long times. Coatings with appreciable detail are difficult to make or modify and involve using templates, or some other hardware control, which must be changed when a new pattern is to be produced.

In an effort to overcome the problems associated with contact surface coating processes, non-contact processes have been developed. Unfortunately, most non-contact processes involve some form of a spraying procedure, and only have limited control over directionality. Such processes also require a means, such as a template, to produce detailed surface coatings. A spraying technique is also difficult to manage in situations where the droplets touch after being applied to the substrate and coalesce into larger drops before drying.

It is particularly desirable in the pharmaceutical industry to be able to provide a substrate covering, such as a medicated pad or bandage, wherein the medication is uniformly, controllably applied to the skin surface.

It is seen then that there exists a need for an improved surface coating applicator process which overcomes the problems associated with the prior art.

Summary of the Invention

This need is met by the continuous flow ink jet general purpose surface coating applicator process according to the present invention, wherein a fast, non-contact coating method provides quasi-uniform surface density coating with excellent reproducibility.

In accordance with one aspect of the present invention, a method is used to apply a coating substance to an ink jet printer substrate. The method comprises the steps of dissolving the coating substance in a carrier fluid to create a coating product, and applying a controllable pattern of discrete droplets of the coating product onto the substrate. This produces a uniform, controllable surface coating on the ink jet printer substrate. The surface coating is typically a liquid solution. The coating product is expelled by the ink jet printer as uniform, controllable, discrete droplets, onto the substrate, and the carrier fluid is allowed to evaporate, leaving the coating substance on the substrate.

Accordingly, it is an object of the present invention to provide a quasi-uniform surface density coating over broad areas. It is a further object of the present invention to provide such a coating having excellent reproducibility over long periods of time. It is yet another object of the present invention to provide excellent pattern versatility.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

Brief Description of the Drawings

Fig. 1 is one illustration of a coating pattern obtained in accordance with the present invention; and
Fig. 2 is a flow chart diagram detailing the steps for applying the coating product, in accordance with the present invention.

Detailed Description of the Preferred Embodiments

The coating method according to the present invention is particularly for use on a continuous ink jet printing system of the type wherein droplets of essentially identical size and volume are produced at high frequencies and can be individually selected to either print on a substrate or be captured and internally recirculated.

In accordance with the present invention, the substance to be deposited as a coating is dissolved in a solution of ink, alcohol, water, or any fluid that is compatible with the fluid system materials. For proper operation of the print head, as is typical, the stimulation operating point must be established for this fluid and the resistivity determined. If needed, the composition of the fluid may be changed to increase the conductivity in order to provide for adequate droplet charging and deflection. Although no well-defined upper limit exists for the fluid resistivity, an accepted value is approximately 5000

ohm-cm.

One coating pattern, illustrated in Fig. 1, is obtained by sending the proper sequence of print pulses to printhead 10 and moving the substrate 12 at a uniform velocity past the printhead, in the direction of arrow 14. As will be obvious to those skilled in the art, the proper sequence of print pulses is a function of substrate speed, droplet size, and generation frequency. Of course, concentration of the solution will also affect the sequence of print pulses.

Continuing with Fig. 1, in accordance with the present invention, the coating procedure is to put discrete droplets of a coating product 16 onto the substrate 12. A coating substance, such as a medication to be absorbed into the skin, is dissolved in a carrier fluid, such as water or alcohol, to create the coating product 16. A controllable pattern of discrete droplets of the coating product 16 is expelled onto the substrate 12 by the printhead 10. The substrate may be any suitable substrate, such as a bandage. The carrier fluid may then be evaporated off the substrate, leaving only deposits 18 of the coating substance. Spacings between the droplets are preferably large enough to prevent droplet coalescing before the coating dries, and/or the carrier fluid evaporates.

Referring now to Fig. 2, and continuing with Fig. 1, droplets 16 are printed such that one droplet does not contact any other droplet after arriving at the substrate 12. Therefore, when the droplets 16 dry, individual deposits 18 of residue remain on the substrate 12. Initially, then, a coating substance and a carrier fluid are provided, as indicated by blocks 20 and 22 of Fig. 2. The coating substance, for example a steroid compound, is mixed as a true solution with a carrier fluid, for example an alcohol such as ethanol, as indicated by block 24. The resultant coating product is then printed on the substrate, as indicated by block 26. When the alcohol evaporates from the printed droplet, at block 28, then the steroid remains on the substrate as individual deposits of crystallites, as indicated at block 30, to be absorbed into the skin when the substrate is applied to skin.

Consequently, after printing the droplets 16 onto the substrate, the carrier fluid will evaporate, leaving behind deposits 18 of the coating material. As will be obvious to those skilled in the art, the rate of evaporation will depend on the carrier fluid used and the ambient and substrate conditions. Also relevant, of course, is the degree to which the solution is absorbed into the substrate. If a highly absorbent substrate material is chosen, then the process of the present invention may be useful as a very controllable and versatile surface impregnator. Conversely, if the substrate does not absorb the solution, then the individual droplets will evaporate with very similar drying times, leaving behind small crystallites of the coating material.

Since the droplets all have nearly identical volumes and the droplets on the substrate are not in contact with each other, when using an ink jet printing system of the type manufactured by Scitex Digital Printing, Inc., of Dayton, Ohio, very uniform crystalline growth can be maintained from droplet-to-droplet. In this way, powders of uniform particle size may be produced after removing the material from the substrate. After the individual droplets arrive at the substrate and the carrier fluid evaporates, the crystallites that are left behind tend to be very uniform in size. Not only is the coating applied through a fast, non-contact process, but the actual crystallites of coating material that remain on the substrate were very uniform in size. In accordance with the present invention, therefore, a substance with a typically large variation in particle size can be created with a very uniform particle size. The deposits, or coating, then, is flaked off the crystallites. Therefore, the end product is not a coating, but is another powder, with very controlled and uniform particle size. If a single layer of the coating material does not provide the required average surface density, another layer may be applied after the previous layer has dried. Hence, the coating method according to the present invention can be used to apply thick, as well as thin, coatings.

Industrial Applicability and Advantages

The present invention is useful in the field of ink jet printing, and has the advantage of allowing for a quasi-uniform surface density coating over broad areas with excellent reproducibility over long time periods. The coating procedure of the present invention is particularly useful when applied to a printing system wherein droplets of essentially identical size and volume are produced at high frequencies and can be individually selected to either print on a substrate or be captures and internally recirculated. It is an advantage of the present invention that coatings can be produced at a throughput of up to 120 inches/second. It is a further advantage of the present invention that the uniformity of the coating can be made very reproducibly and at virtually any value of surface density. Finally, it is an advantage of the present invention that the versatility of the system is such that a variety of coating pattern can be produced in any number or order of the desired pattern.

Having described the invention in detail and by reference to the preferred embodiment thereof, it will be apparent that other modifications and variations are possible without departing from the scope of the invention defined in the appended claims.

Claims

1. A method for applying a surface coating to an ink jet printer substrate, the method comprising the steps of:

   dissolving a coating substance in a carrier fluid to create a coating product;

applying a controllable pattern of discrete droplets of the coating product onto the substrate.

2. A method for applying a surface coating as claimed in claim 1 further comprising the step of applying multiple layers of the coating product to the substrate.

3. A method for applying a surface coating as claimed in claim 1 wherein the coating substance comprises a medication.

4. A method for applying a surface coating as claimed in claim 3 wherein the medication is absorbable through skin.

5. A method for applying a surface coating as claimed in claim 3 wherein the medication is dissolvable in the carrier fluid.

6. A method for applying a surface coating as claimed in claim 1 wherein the coating substance comprises a steroid compound.

7. A method for applying a surface coating as claimed in claim 1 wherein the carrier fluid comprises alcohol.

8. A method for applying a surface coating as claimed in claim 1 wherein the carrier fluid comprises ethanol.

9. A method for applying a surface coating as claimed in claim 1 wherein the carrier fluid comprises water.

10. A method for applying a surface coating to an ink jet printer substrate, the method comprising the steps of:

providing a coating substance;
providing a carrier fluid;
mixing the coating substance and the carrier fluid to create a coating product;
printing the coating product on the substrate as a printed droplet;
allowing the carrier fluid to evaporate from the printed droplet;
leaving individual deposits of the coating substance on the substrate.

FIG. 1

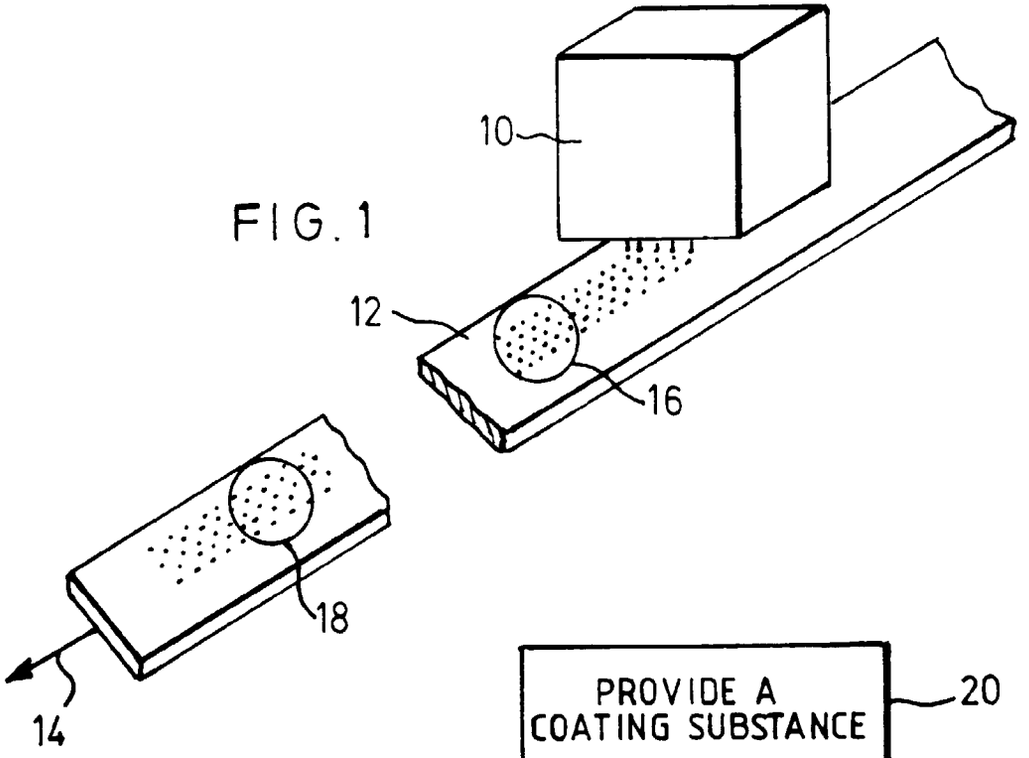
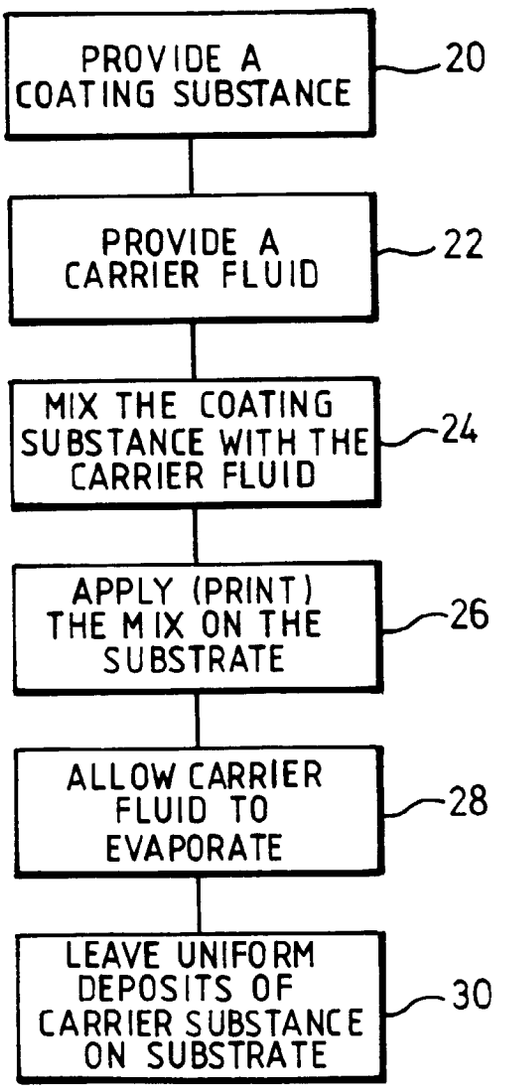

10
12
16
18
14

FIG. 2


PROVIDE A COATING SUBSTANCE
20
PROVIDE A CARRIER FLUID
22
MIX THE COATING SUBSTANCE WITH THE CARRIER FLUID
24
APPLY (PRINT) THE MIX ON THE SUBSTRATE
26
ALLOW CARRIER FLUID TO EVAPORATE
28
LEAVE UNIFORM DEPOSITS OF CARRIER SUBSTANCE ON SUBSTRATE
30