United States Patent

Perley

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[54] **TRANSFER ELECTROSTATIC PRINTING SYSTEM**

[72] Inventor: **Richmond Perley,** Glastonbury, Conn.

[73] Assignee: **United Aircraft Corporation,** East Hartford, Conn.

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[52] **U.S. Cl.** .....**346/74 ES,** 101/DIG. 13

[51] **Int. Cl.**....**G03g 15/16,** G03g 15/20, G03g 15/22

[58] **Field of Search** .....346/74 ES; 101/DIG. 13

[56] **References Cited**

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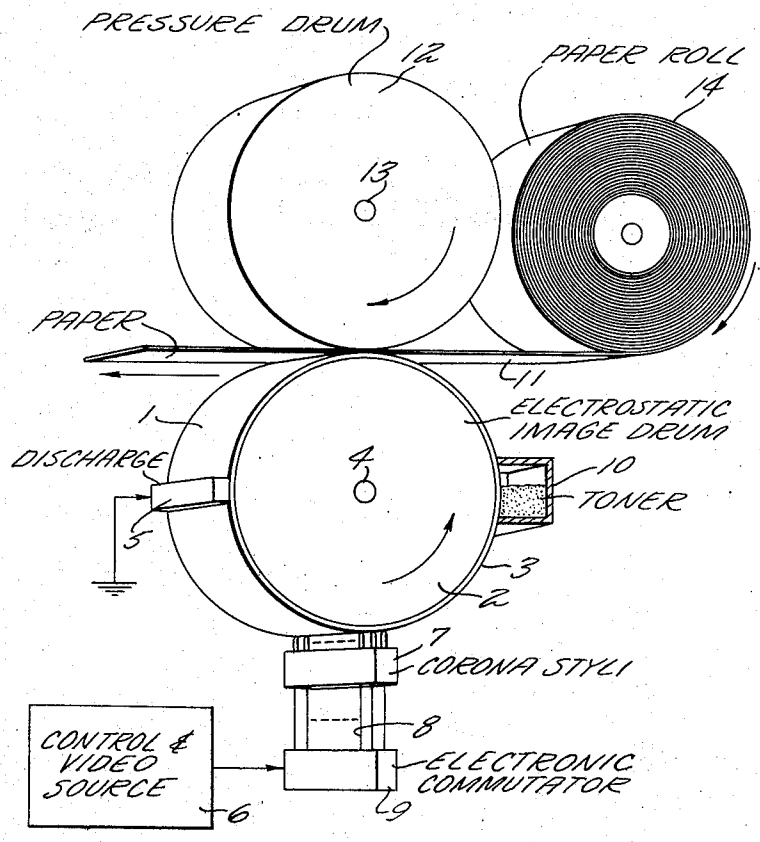
Primary Examiner—Howard W. Britton

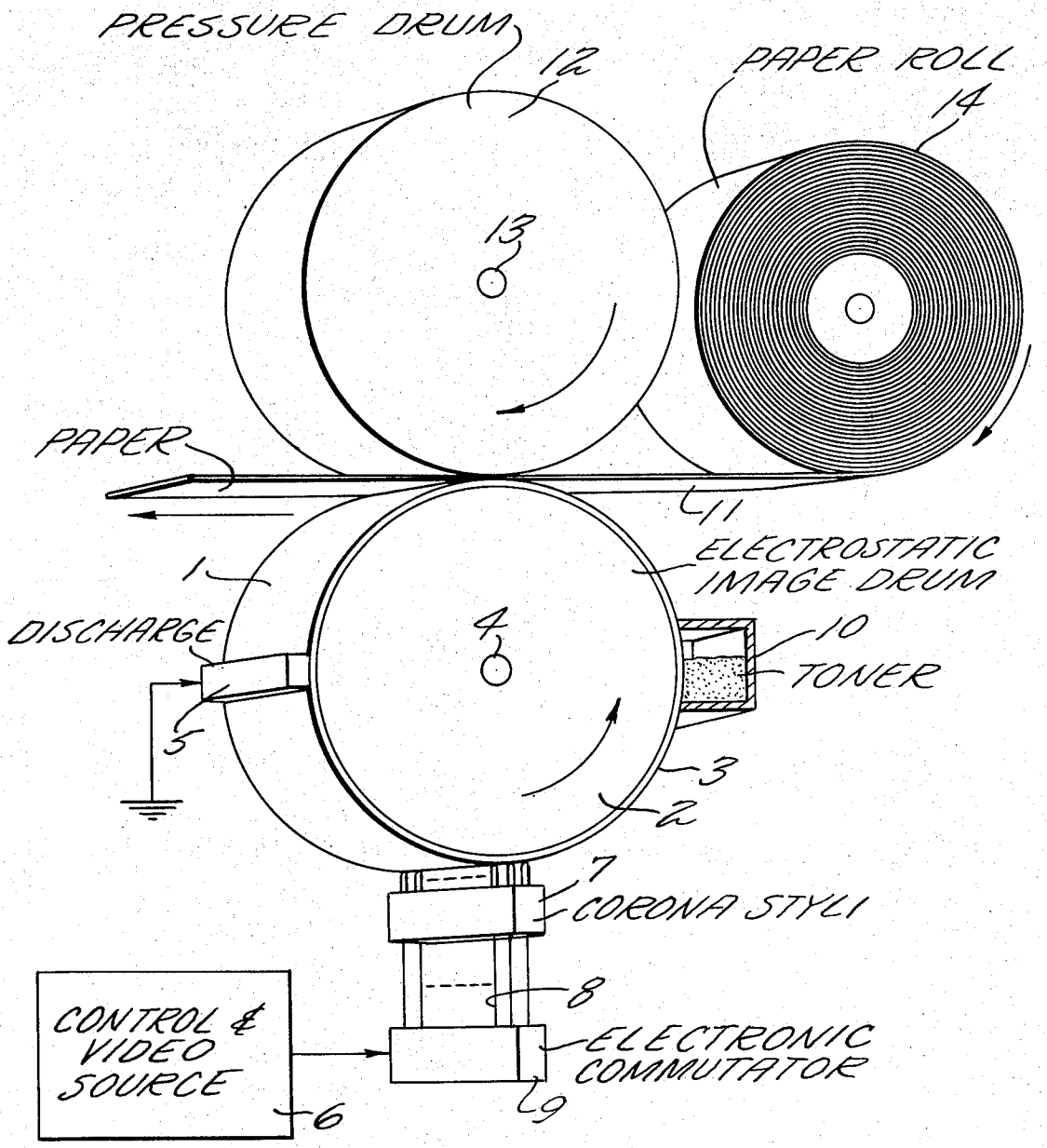
Attorney—Melvin Pearson Williams

[57] **ABSTRACT**

This printing system utilizes an electrostatic drum to selectively receive charges from a row of corona styli, the charges attracting dry toner particles so as to form a selective row of dots, a plurality of dot rows capable of presenting an image of language text or a plot of graphical information. The toner is embedded in the image receiving paper as the paper passes between the electrostatic image drum and a cooperating pressure drum. Auxiliary transfer processes, heat or moisture and charge/selective erase processes are all eliminated.

4 Claims, 1 Drawing Figure





INVENTOR
RICHMOND PERLEY
BY Melvin Pearson Williams
ATTORNEY

TRANSFER ELECTROSTATIC PRINTING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of Invention

This invention relates to electrostatic printing, and more particularly to a direct utilization of tonered, selective charge images in a combined pressure transfer/fusing process.

2. Description of the Prior Art

Electrostatic printing processes have long been known. Although the most familiar type is used in document copying systems, such processes are also widely used in document generating systems. Such systems require, in some cases, the use of a specially treated paper which is expensive and renders the paper less acceptable, aesthetically. In such systems, an electrostatic image may be created directly on the pretreated paper, after which toner is applied to the paper and fused therein. In other systems, toner is applied to the electrostatic drum or other medium, and only the toner is transferred to the paper. However, such systems generally require an electrostatic image drum, and an intermediary medium or drum for selectively removing the tonered image from the electrostatic drum, for transfer to paper. Even thereafter, the paper is generally heated or moistened so as to fuse the toner particles to the paper in order to create a pseudo permanent record. In most processes, the electrostatic image drum is of the type which is first charged, and is later selectively discharged in accordance with a pattern.

It has been found that the degree of success of electrostatic printing processes is dependent upon the simplicity of the apparatus so as to render it capable of withstanding hard use at a very high duty cycle. Also, since high speed custom printing of this type is usually utilized in individual offices and departments, the overall capital investment and per copy cost of the process must be extremely low.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a simplified and improved electrostatic printing apparatus.

According to the present invention, a direct transfer electrostatic printing apparatus utilizes an electrostatic image drum to selectively create charge patterns conforming to desired images, the charge patterns having toner applied thereto to develop the image, the toner being directly applied to and fused into the image receiving medium, such as paper, by direct pressure between the electrostatic image drum and a cooperating pressure drum.

The present invention eliminates the need for heat and moisture, and intermediary image transferring apparatus. Since the apparatus is simple and direct, it is capable of implementation at low cost and with high reliability. The apparatus in accordance herewith may be produced with known technology, and may utilize trains of video signals from available processing apparatus.

The foregoing and other objects, features and advantages of the present invention will become more apparent in the light of the following detailed description of a preferred embodiment thereof, as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The sole FIGURE herein comprises a simplified isometric illustration of a preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, an electrostatic image drum **1** comprises a main body portion **2** which may be formed of a suitable metal with a thin outer layer **3** of a hard dielectric material, such as ceramic and is disposed for rotation about a shaft **4**, as is known in the art. The dielectric layer **3** may be on the order of a few mils thick. The electrostatic image drum **1** is in proximity of an electric neutralizing or discharge station **5**, which may be grounded.

Disposed adjacent the surface of the drum **1** are a plurality of electrostatic styli **7**, each stylus being electrically conductive and structured to induce a corona discharge (such as by having a sharpened point at the end adjacent to the periphery of the image drum **1**). Each stylus is connected by suitable corresponding wires **8** to an electronic commutator **9** which can cause a stream of binary image video signals supplied thereto by a control and video source **6**, of a known type, to be distributed to sequential ones of the styli, in a fashion similar to the creation of light images with a sweeping cathode ray beam. Thus, the invention may be practiced by scanning the styli for selectively implanting a charge when the styli relates to a desired dot in a matrix of dots to form an image. In such a case, a portion of the control and video source circuit **6** may take the form of the binary image signal generation means disclosed in a copending application of the same assignee entitled GRAPHICAL DATA PROCESSING SYSTEM, Ser. No. 67,185, filed on Aug. 26, 1970, by Myers et al. Such a system will present binary image data in a suitable form so that the styli **7** would be selectively energized in a cross-drum scan, repetitively, as the drum rotates; 8, 16 or 32 (or some other convenient number) of dots being sufficient to print a line of characters. Of course, any number of successive rows of dots may be utilized in printing graphics.

As the drum rotates past a toner station **10**, the toner is electrostatically attracted to those dot-areas of the drum where a charge has been implanted by the styli **7**. The toner station **10** may be provided with mechanical agitation means so as to induce a static charge, of a polarity opposite to that applied by the styli **7**, in the charged particles through the triboelectric effect, as a result of friction between the particles. Any suitable well known electrically chargeable, dry powder toner may be used. However, in accordance with the present invention, the toner need not be moistenable or heat fusing since its transfer and application are achieved in the single contacting of the electrostatic image drum **1** with an image receiving medium or web such as paper **11**.

The paper **11** passes between the electrostatic image drum **1** and a pressure drum **12** which is disposed for rotation on a suitable shaft **13**. The pressure drum is arranged, by any well known means not shown, to apply a suitable force against the electrostatic image drum so that the toner is diffused into the paper as a result of compressive force between the two drums. A suitable

pressure may be on the order of 300 pounds per lineal inch of contact between the drums. In other words, if the paper is 10 inches wide, a compressive force of approximately 3,000 pounds should be maintained between the drums **1, 12**.

The paper **11** may be fed from any suitable paper roll **14**, and may in fact provide incremental feed with sheet cutting and other features of the type disclosed in a copending application of the same assignee entitled PRINTER/PLOTTER SHEET TRANSPORT, Ser. No. 67,168, filed on Aug. 26, 1970 by Sharp et al., now U.S. Pat. No. 3,624,289. However, these features form no part of the present invention, and have been eliminated herefrom for simplicity.

One of the essential features of the present invention is that the dielectric layer **3** on the drum **1** be sufficiently hard so as to resist any tendency of the toner to adhere thereto as the paper **11** is pressed between the rolls **1, 12**. It also must have suitable dielectric properties. Therefore materials such as ceramics are to be preferred to softer materials such as fluorocarbons.

Thus there has been shown and described a direct imaging, developing transfer, and fusing electrostatic printer in accordance with the invention. However, although shown and described with respect to a preferred embodiment thereof, it should be understood by those skilled in the art that various changes and omissions in the form and detail may be made in the present invention, without departing therefrom.

Having thus described a typical embodiment of my invention, that which I claim as new and desire to secure by Letters Patent of the United States is:

1. A transfer electrostatic printing apparatus comprising:

an electrostatic image drum having a relatively hard dielectric surface layer disposed over an electrically conductive surface, and adapted for rotation in a given direction;

a plurality of corona styli of the type that induces a corona discharge, and styli disposed adjacent the surface of said drum;

means disposed adjacent the periphery of said drum in the direction of rotation from said styli for depositing toner particles on discrete areas of said drum charged by said styli;

a source of image receiving medium;

a pressure drum disposed adjacent the periphery of said image drum in the direction of rotation from said toner means, said pressure drum and said image drum cooperating to roll said image receiving medium therebetween as said drums rotate, said pressure drum adapted to apply a substantial pressure to said image receiving medium against said image drum, whereby a pattern of toner on said image drum is simultaneously transferred and pressure-fused into said image medium.

2. The printing apparatus according to claim **1** wherein said layer comprises ceramic.

3. The printing apparatus according to claim **1** wherein said layer is on the order of a few mils thick.

4. The printing apparatus according to claim **1** wherein said pressure drum is adapted to apply a pressure on the order of 300 pounds per lineal inch to said image receiving medium against said electrostatic image drum.

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