

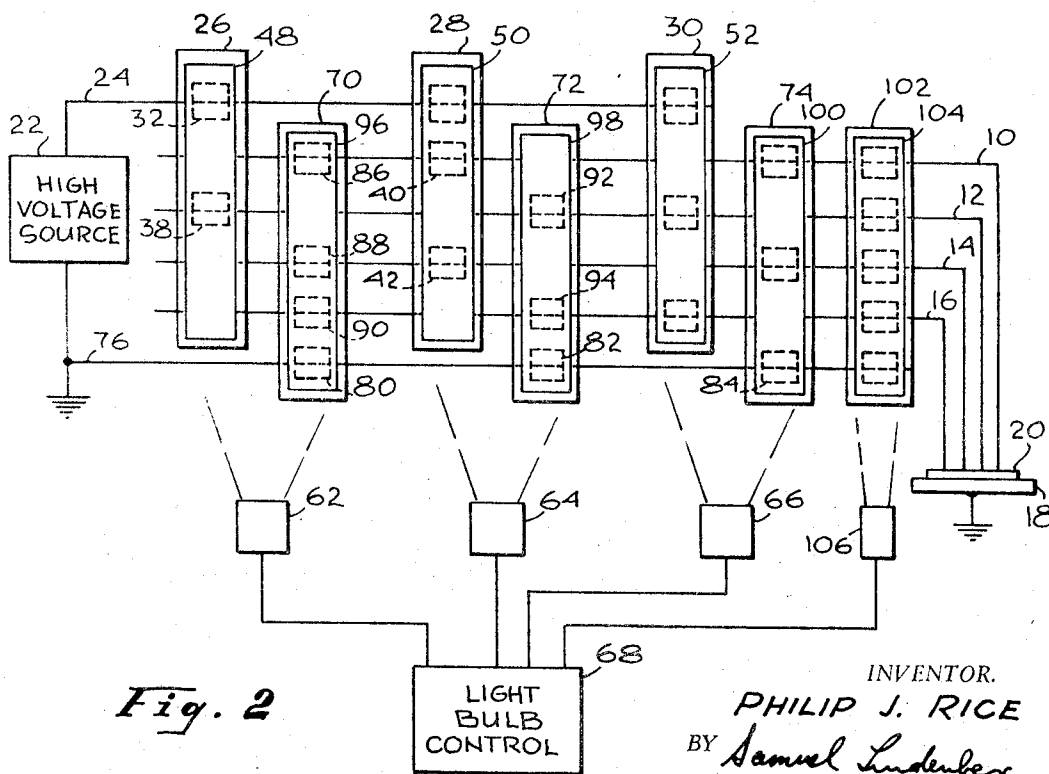
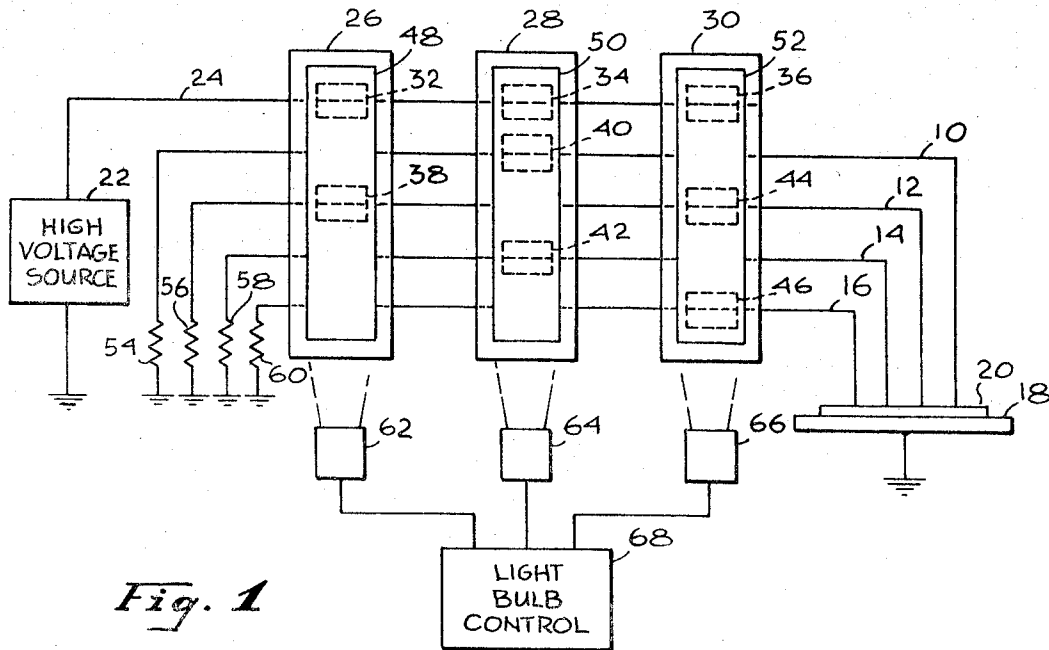
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LIGHT ADDRESSED MATRIX PRINTER

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LIGHT ADDRESSED MATRIX PRINTER

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4 Claims

ABSTRACT OF THE DISCLOSURE

In an arrangement for electrostatic printing which uses photoconductive material as a bridge between high voltage wire and selected wires of a grid matrix so that when the photoconductive material is illuminated these wires can assume a high potential to provide electrostatic deposition from their ends, the improvement which comprises photoconductive material bridging the unselected wires of the bridge matrix and illuminated simultaneously with the original illumination to connect the unselected wires to a ground wire.

This invention relates to printers of the type which employ a wire grid matrix as a printing transducer and more particularly to an improvement in the switching system for wire grid matrix printers.

A wire grid matrix printer, or dot matrix printer, normally comprises an array of wires the points of which are spaced opposite a backbar. Paper, which is to be written upon, is inserted between the points of the wire matrix and the backbar. A voltage is applied to each one of the wires, the points of which are disposed in the form of a desired character. When this voltage exceeds a predetermined threshold value, a voltage discharge occurs which deposits a charge on the paper. In this manner, an electrostatic charge pattern is deposited on the paper. The paper is then moved to a developing position where it is developed with the usual and well-known triboelectric toning powders.

In an application for patent by Albert Macovski, entitled "Light Addressed Matrix Printer," Ser. No. 485,505, filed Sept. 7, 1965 and assigned to a common assignee, there is described an arrangement for addressing the wires which comprise the wire grid matrix. This application describes and claims the use of photoconductive material disposed so that the high voltage wire is connected to selected wires of the grid matrix which, when high voltage is applied thereto, provide an electrostatic deposition in the pattern of the desired character. Light is used to reduce the resistance of the photoconductive material to enable a sufficient voltage to be applied to the wires connected to the photoconductive material from the high voltage wire. The system thus provides a light addressed matrix printer.

In the arrangement described in the foregoing application, photoconductive material connects the high voltage wire to a wire in the matrix printer and a resistor then connects the matrix printer to ground. The rise time or time required for photoconductive material to go from its high resistance value to its low resistance value when illuminated, is quite short. However the decay time or time required for the photoconductive material to return to its high resistance value from its low resistance value is considerably longer than its rise time. As a result, when the light illuminating the photoconductive material is turned off, the wires to which the high voltage was applied are not as quickly discharged from the high voltage as is desired. In order to overcome this problem, a resistor is connected between each wire and ground for the purpose of bleeding off residual voltage after the photo-

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conductive material in contact with that wire is no longer illuminated, and also to attenuate the voltage applied to that wire via the photoconductive material when it has its dark resistance value. A held over voltage has the effect of causing unwanted electrostatic discharges on the paper on which the writing occurs. This serves, when developed, to provide a smeared appearance or dirty background to the electrostatic printing.

Accordingly, an object of this invention is to provide an improved light addressing arrangement for the wires of a wire grid printer.

Another object of this invention is to provide the unique and inexpensive arrangement for addressing the wires of a wire grid printer.

Yet another object of this invention is to provide a novel and improved wire grid selection and printing system.

These and other objects of the invention are achieved in an arrangement of the type described wherein, instead of providing a resistor which connects each wire of the matrix to ground, there is provided instead an insulating mask with holes therein for every one of the masks used for addressing the matrix wires. The holes in each of these second masks are positioned over those wires which are not addressed by the associated first mask. Photoconductive material is then applied to the second mask in a manner to come in contact with the wires exposed thereby. A ground line is connected to the photoconductive material of each of these second masks. The light which illuminates the photoconductive material of each first mask also illuminates the photoconductive material covering each of these second masks. As a result, the non-selected wires are grounded. Thus whenever a light is illuminated, the non-selected wires are connected to ground and the selected wires are connected to high voltage via the photoconductive material.

Upon the selection of another set of wires by illuminating a second first and second mask, if the same wire is selected again by the second illumination, then, obviously it will be connected to the high voltage line. If the wire previously excited is not selected by the second illumination, then it is connected to ground by the then illuminated second mask. At the end of a writing interval, if desired, photoconductive material may be illuminated which serves to connect all of the wires of the matrix to ground.

The novel features that are considered characteristic of this invention are set forth with particularity in the appended claims. The invention itself both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description when read in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of a light addressed matrix printer illustrative of the prior art; and

FIGURE 2 is a schematic diagram of a light addressed matrix printer in accordance with this invention.

Referring now to FIGURE 1, there may be seen a schematic drawing of a light addressed matrix printer in accordance with the claimed structure of the patent application by Albert Macovski. While a wire grid matrix for electrostatic writing may have a large number of wires, to simplify the drawing and explanation, four writing wires respectively 10, 12, 14 and 16 are shown in FIGURE 1. The points of these wires terminate in a plane opposite a ground plate 18. Between the ground plate 18 and the wire ends the paper 20, or other material to be written upon, is drawn. When the voltage potential applied to any one of the wires 10, 12, 14, 16, exceeds a threshold value, determined by such parameters as the size of the wire point, the spacing from the ground plane, and the characteristics of the paper 20, a discharge occurs from these wire points to the ground plane depositing

charges on the surface of the paper in a pattern determined by the number of wires which have made this discharge substantially simultaneously. The paper is then moved to a developing and fixing location (not shown) in which well-known xerographic techniques are employed.

A high voltage source 22 applies voltage between ground and a high voltage wire 24 which exceeds the required discharge threshold. While as many combinations of the writing wires may be selected for writing as there are characters wished to be written, only three selection means are shown in FIGURE 1 to simplify the drawing as well as the explanation of this invention. Each one of these selection means includes an insulating mask respectively 26, 28, 30. Each mask has one hole 32, 34, 36, respectively which opens on the high voltage wire 24. The other holes in each mask, for example, 38, in mask 26, 40, 42, in mask 28, and 44, 46 in mask 36, are placed over those of the wires which when connected to the high voltage will produce a charge image on the paper representative of the character with which each mask is associated. Thus, mask 26 may be associated with the printing of a period, mask 28 with the printing of a colon, etc.

Photoconductive material respectively 48, 50, 52, is deposited over each of the masks 26, 28, 30, to coat the wires which show through the holes in each mask, and also to form a continuous piece of photoconductive material between the holes. In other words, the high voltage wire is coupled to each of the wires exposed by the holes in the mask by means of the photoconductive material. A resistor respectively 54, 56, 58, and 60 is connected between each one of the wires 10, 12, 14, 16 and ground. The value of these resistors is selected to be approximately the geometric mean between the dark and the illuminated resistance of the photoconductors which connect the high voltage wire to the writing wires, so that the value of these resistors is low compared to the dark resistance of the photoconductive material and high relative to the illuminated resistance. In this manner, each resistor forms with the photoconductive material, a voltage divider which greatly attenuates the voltage at each undesired wire without significantly affecting the voltage at each desired wire.

In order to effectuate the writing of the desired character, one of the three lamps respectively 62, 64, 66, is selected which illuminates the photoconductive material on the mask associated with the desired character. A light bulb control source 68 is representative of the light bulb selection signal source. Upon the energization of a light, such as 64, then the photoconductive material 50 will have its resistance value reduced to the extent that the voltage applied to the wires 10, 14, raise the voltage level of these wires above the writing threshold whereupon a discharge occurs at the writing position at which the paper is located.

The arrangement described operates satisfactorily and adequately and constitutes briefly an arrangement as described in the foregoing application by Albert Macovski. As previously pointed out, the rise time or alteration of the photoconductive material from its low resistance value occurring when it is illuminated, to its high resistance value, occurring when it is not illuminated, is relatively slow, and this together with the capacitance of the wire grid results in a remaining potential which is not discharged through the respective resistors 54, 56, 58, 60 sufficiently rapidly to prevent some smearing from occurring on the paper. An arrangement such as is shown in FIGURE 2 has been devised which operates to ground non-selected writing wire at the time that selected writing wires are energized. In this manner, the undesirable effects described are eliminated.

FIGURE 2 comprises the arrangement shown in FIGURE 1 with the additions in accordance with this invention for obtaining the desired improvement. Apparatus in FIGURE 2 which has the same function as the ap-

paratus in FIGURE 1 bears the same reference numerals. Accordingly, this apparatus will not be redescribed. In accordance with this invention, for each character selecting mask 26, 28, 30, there is provided a grounding mask 70, 72, 74. Each of these grounding masks also comprises a sheet of insulating material which has openings therethrough placed so that when each grounding mask is laid over the writing wires adjacent the character selection mask, the openings will fall over the wires which are not selected by the associated character selecting mask. In addition, these grounding masks are not placed over the high voltage wire 24 but are placed over a grounding wire 76, and an opening respectively 80, 82, 84, is provided in each mask over said grounding wire 76.

Since the mask 26 has an opening 38 over the wire 12, the mask 70 will have the respective openings 86, 88, 90, over the wires 10, 14, and 16. Since mask 28 has openings 40 and 42 over wire 10 and 14, the associated grounding mask will have openings 92 and 94 over wires 12 and 16. In this manner, each grounding mask enables photoconductive material respectively 96, 98, and 100 to connect the wires exposed through the openings to the ground wire 76.

This time, when a lamp such as 62 is illuminated from the light bulb control 68, it illuminates the conductive material 48 and 96 on the selecting mask 26 and the grounding mask 70. The wire 12 has a high potential applied thereto and the wires 10, 14, 16 are connected to ground substantially simultaneously therewith. When the light source 62 is turned off and the light 64 is turned on, wires 10 and 14 are connected to high voltage and the other wires 12 and 16 are connected to ground. Thus, any charge which remained on the wire 12 from its previous excitation is quickly removed to prevent any adverse effects.

It may be desirable at the end of a printing period and before the commencement of a subsequent printing period to ground all the writing wires. This is achieved by providing an additional mask which may be termed an end-of-message mask, or end-of-line mask 102. This mask has holes therethrough over every one of the writing wires as well as the ground wire. Thus the photoconductive material 104 which is deposited thereover, when illuminated by the light 106, serves to connect every one of the wires 10, 12, 14 and 16 to the ground wire 75, discharging them so that there is no hold over of charge for the next writing.

There has accordingly been described and shown herein a novel, useful and unique arrangement for selection of the wires in an electrostatic writing matrix in a manner so that hold over charge from a previous selection is eliminated.

What is claimed is:

1. A wire grid matrix printer system comprising a plurality of writing wires having their ends terminating in a writing plane, a backbar spaced opposite said writing plane, and means for selecting for the application of writing potential predetermined ones of said writing wires comprising a source of writing potential, an energizing wire connected to said source, first photoconductive material means for bridging the space between said energizing wire and said predetermined ones of said writing wires in said matrix, means for illuminating said first photoconductive material means when it is desired to apply potential from said source to said predetermined writing wires, a grounding wire connected to said source, second photoconductive material means for bridging the space between said grounding wire and the remaining ones of said writing wires, said second photoconductive means being positioned to be illuminated together with said first photoconductive material means.

2. Apparatus as recited in claim 1 wherein said first photoconductive material means for bridging the space between said energizing wire and said predetermined writing wires includes a mask made of insulating material,

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said mask being placed adjacent to all of the writing wires of said wire grid matrix and said energizing wire, said mask having openings therethrough only over said predetermined writing wires and over said energizing wire, and photoconductive material is coated on said mask and extends through the openings therethrough to cover said predetermined writing wires and said energizing wire, and wherein said second photoconductive material means for bridging the space between said grounding wire and said predetermined writing wires includes a mask made of insulating material, said mask being placed adjacent to all of the writing wires of said wire grid matrix and said grounding wire, said mask having openings therethrough only over the remaining ones of said predetermined writing wires and over said grounding wire, and photoconductive material is coated on said mask and extends through the openings therethrough to cover said remaining ones of said writing wires and said grounding wire.

3. In a wire grid matrix printer of a type adapted to produce an electrostatic image of a dot pattern of a plurality of characters by the selective application of writing voltages to the writing wires of said wire grid matrix, an improved wire energization system for each character to be written comprising first means for insulatingly covering a portion of all of the writing wires of said wire grid matrix except for those writing wires which when energized provide an electrostatic image of a character desired to be printed, second means for insulatingly covering a portion of the writing wires which are not covered by said first means, means for applying an energizing voltage to said writing wires which are not insulatingly covered by said first means comprising a high voltage lead, a ground terminal, photoconductive material extending from said high voltage lead to each one of said writing wires which are not covered by said first means, a ground lead extending from said ground terminal, photoconductive material extending from said ground lead to each one of said leads which are uncovered by said second means, and illumination means for illuminating said photoconductive material for reducing the resistance value thereof whereby

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said high voltage lead is connected through said illuminated photoconductive material to said writing wires which are not covered by said first means to enable them to write said predetermined character, and said ground lead is connected through said illuminated photoconductive material to said writing wires uncovered by said second means to substantially ground said wires.

4. Apparatus as recited in claim 3 wherein said first means for insulatingly covering a portion of all of said writing wires except those which when energized write said desired character comprises a mask made of insulating material for covering all of said wires of said wire grid, said mask having openings therethrough over said wires which when energized result in writing said desired character, said second means for insulating all of said wires which are not insulated by said first means comprising a second mask made of insulating material for covering all of said wires of said wire grid, said mask having openings therethrough over said wires a part of which are insulated by said first means, said photoconductive material being applied over said first and second masks and through the apertures therein to contact the wires exposed through said apertures.

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