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

(11) Publication number: **0 186 059**
B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **27.06.90**

(51) Int. Cl.[5]: **B 41 J 2/335**

(21) Application number: **85115850.1**

(22) Date of filing: **12.12.85**

(54) **Thermal print head.**

(30) Priority: **28.12.84 US 687069**

(43) Date of publication of application:
02.07.86 Bulletin 86/27

(45) Publication of the grant of the patent:
27.06.90 Bulletin 90/26

(84) Designated Contracting States:
BE DE FR GB

(56) References cited:
EP-A-0 112 472
EP-A-0 112 473
GB-A-1 599 216
US-A-4 428 690
US-A-4 513 296

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EP 0 186 059 B1

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Courier Press, Leamington Spa, England.

Description

This invention relates to thermal print heads as recited in claims 1 and 4.

In typical heads, a row of electrically resistive heating elements is defined along the length of a resistive stripe by a series of conductive fingers which cross the stripe at regular intervals. Each heating element is thus spaced apart from the next element by the width of the finger which separates them and each element is bordered by and connected to the two associated fingers which define the element. In order to print a dot on a sheet of heat-sensitive paper, an individual element is heated by driving current through it. A voltage is applied to one of the element's two associated fingers to supply power, and the other finger is grounded to withdraw (sink) power from the element. By printing a set of selected dots in one row, then moving the paper a short distance (in a direction perpendicular to the resistive stripe) to a new position at which another set of selected dots is printed, and then repeating these steps, patterns of dots corresponding to alphanumeric characters or graphic symbols are formed.

Typically, every other finger along the stripe extends in one direction away from the stripe to connect to integrated circuitry which is arranged to permit grounding of various ones of the fingers at different times. The intervening fingers (to which the voltage is to be applied) are not connected to the grounding integrated circuitry, but instead extend away from the stripe in the opposite direction from the grounding fingers. Every other one of these voltage fingers is routed to a first bus which runs parallel to the stripe, while the remaining voltage fingers are routed to a second bus, which also runs parallel to the stripe.

The printing of dots along a row is done in two phases a voltage is applied first to the first bus, and appropriate grounding fingers are grounded to cause heating of the elements corresponding to the desired dot positions and then to the second bus, and other appropriate grounding fingers are grounded.

Diodes are connected between each voltage finger and the bus to which it is routed to prevent so-called parasitic voltages from appearing on the bus to which the voltage which was not applied. Such parasitic voltages may erroneously cause printing by elements which were not selected for heating. Such diodes affect the complexity and reliability of the switching circuitry and contribute to the design and manufacturing costs of the print head.

One printing head known in the prior art is disclosed in US patent No. 4 513 296. There is disclosed a thermal printing head which comprises two rows of contiguous heating elements, wherein the elements of one row is offset by one-half printing space from the elements in the second. In operation, when adjacent elements in one row are energized there is no gap or space between the dots printed, and the elements in the second row are energizable so to partially overlap dots printed by the first row.

A second printing head known to the prior art is disclosed in EP—A—0 122 472, which discloses a printing head comprising two contiguous heating elements which may be operated as a variable dot or pixel size generator, wherein pixels are formable by the use of one to four overlapping heating elements which comprise the heating elements.

It is therefore an object of the invention as defined in the appendent claims to avoid these deficiencies and to provide an improved thermal printing head.

To one of several buses a first voltage level is applied which is at least sufficient, when applied to one of the elements, to cause marking, while holding a second bus at a fixed second voltage level insufficient for causing marking.

It is therefore an object of the invention as defined in the appendent claims to avoid these deficiencies and to provide an improved thermal printing head which results in dense undisturbed printing and is less costly to manufacture.

The heating elements are arranged in rows, (e.g. two parallel rows), and there are a series of conductors for sinking power from the elements, with every other one of these conductors extending on one side of the rows, and the intervening conductors extending on the other side, with each conductors serving two elements on each row, and each element being served by one of the conductors; and there are four buses (double the number of rows), with two of the buses being arranged on one side of the rows so as to be adjacent to and to serve one of the rows, and with the other two buses being arranged on the other side of the rows so as to be adjacent to and to serve the other one of the rows.

In a preferred embodiment, the elements are regularly spaced along the rows, with spaces between successive elements (each element having, we.g., a length equal to the length of one of the spaces), and one of the rows is offset from the other row (e.g. by an amount equal to the space length) such that in a projection of one row onto the other row, the elements of the one row would cover at least a portion of the spaces along the other row.

In general, the invention features a thermal print head having a number (N) of parallel rows of electrical heating elements for marking a heat sensitive medium, conductors for sinking power from the elements, 2N electrical buses for routine power to the elements, each bus being connected in common to a plurality of elements, and control logic for routing power via each one of the buses in turn.

To one of several buses a first voltage level is applied which is at least sufficient, when applied to one of the elements, to cause marking, while holding a second bus at a fixed second voltage level insufficient for causing marking.

Also in preferred embodiments, the power sinking conductors selectively connect the elements

to a predetermined third voltage level, such that the voltage difference between the first and third voltage levels is sufficient to cause marking, but the voltage difference between the second and third voltage levels, and the voltage difference between the first and second voltage levels, are each insufficient to cause marking; the second voltage level is lower than the first voltage level and is selected to have a value, relative to the first voltage level, which minimizes the aggregate power loss in the heating elements, e.g., a value equal to the third voltage level plus 3/7 of the difference between the first voltage level and third voltage level; control logic is provided for connecting the first voltage level from the power source to a selected one of the buses while connecting the second voltage level from the power source to the other buses; and the control logic connects selected ones of the elements to a power sink while the bus connected to the selected elements is connected to the first voltage level, to cause marking by the selected elements.

By holding the non-printing buses to a fixed second voltage level insufficient to cause marking, no diodes are required to counteract the parasitic voltages which could otherwise appear on the non-printing buses. Eliminating the diodes reduces the design and manufacturing costs and improves the reliability of the head, by making more space available on the head substrate. The availability of space also permits the use of four buses, two on each side of the elements. Four buses enable the use of two rows of printing elements, each served by two of the buses. By connecting each sink conductor to both rows, each sink conductor can serve four elements. Having alternate sink conductors lead out to different sides of the element rows reduces the density of the required switching circuitry on the substrate which reduces design and manufacturing complexity and cost, and improves reliability. Using four buses permits four-stage printing which reduces the peak power load. Offsetting the two rows of elements with respect to each other assures that every loacation on a page can be printed.

Other advantages and features of the invention will become apparent from the following description of the preferred embodiment, and from the claims.

We first briefly describe the drawings.

Fig. 1 is a schematic view of a thermal printing system.

Fig. 2 is a view of a representative segment along the length of the thermal print head of Fig. 1, including integrated circuitry shown schematically.

Fig. 3 is a schematic view of the power supply and control logic of Fig. 1.

Fig. 4 is an equivalent circuit diagram for the head of Fig. 2 reflecting one possible operating condition.

Referring to Fig. 1, in thermal printing system 10 a sheet of temperature-sensitive paper (or plain paper in conjunction with an ink-bearing temperature-sensitive ribbon) 12 is held against a thick-film thermal print head 14. Paper driver 16 is arranged to move paper 12 to a succession of fixed positions with respect to head 14. Paper driver 16 is connected via control signal line 17 and power line 19 to a power supply and control logic 18 (for providing power and control signals to cause paper driver 16 to move paper 12 to the successive positions). Power supply and control logic 18 is also connected via control signal lines 21 and bus power lines 23 to head 14 (for providing power and control signals for causing head 14 to print a desired set of dots with respect to each successive position of paper 12). Power supply and control logic 18 is also connected via control signal line 25 and data line 27 to a microprocessor (not shown) for receiving streams of bits representative of information to be printed, and for receiving and sending related control signals.

Referring to Fig. 2, in head 14, a pair of parallel resistive stripes (each .0833 mm wide) of palladium-silver or palladium-gold 30, 32, are crossed by a series of conductive fingers 34 (each 0.0833 mm wide) also of palladium-silver or palladium-gold. The rows are separated by a 0.25 mm space and the conductive fingers are spaced at regular intervals to define two parallel rows of printing elements 36, 38 (each 0.0833 mm square). Elements 36 are offset from elements 38 along an imaginary axis 40 by a distance of 0.0833 mm such that, if elements 38 were moved along an axis 42 to the location of row 30, each element 38 would fill the space between a pair of adjacent elements 36. There are a total of 2,592 elements along the 8-1/2" (21,6 cm) print head length (only a few are shown in Fig. 2) with 1,296 elements in each row.

The fingers 34 which cross row 30 are arranged in four groups. One group of fingers 44 is connected to a conductive bus 46 oriented parallel to row 30. A second group of fingers 48 (only two are shown in Fig. 2) passes under and is insulated from bus 46 and connects to a second bus 50 also oriented parallel to row 30. A third group of fingers 52 passes under and is insulated from both buses 46 and 50 and connects to integrated circuit 54 (for connecting selected fingers 52 to ground). Fingers 52 also extend to and cross row 32 and have jogs 56 to accommodate the offset betwen elements 36, 38. A fourth group of fingers 57 extend to and beyond stripe 32.

Likewise, the fingers 34 which cross stripe 32 are arranged in four groups, including fingers 52 in one group, fingers 58 which connect to a bus 60 (on the other side of stripes 30, 32 from buses 46, 50) in a second group, fingers 62 which connect to a bus 64 in third group, and fingers 57 which connect to integrated circuitry 66 in a fourth group.

Each finger 52, by virtue of crossing both stripes 30, 32 is connected to four elements, which are served individually by one of the four buses 46, 50, 60, 64. For example, a finger 52 connects to elements 70, 72, 74, 76, which in turn

are connected respectively to buses 46, 50, 60, 64. Likewise, each finger 57 is connected to four elements also served respectively by one of the four buses 46, 50, 60, 64.

Each pair of adjacent fingers 57 has four elements 38 positioned between them, and each pair of adjacent fingers 52 likewise has four elements 36 positioned between them.

Buses 46, 50, 60, 64 are integrated circuits 54, 66 are each connected independently via lines 41, 43, 45, 47, 49, 51 to power supply and control logic 18.

Integrated circuitry 66 represents one of six identical circuits arranged along the length of head 14 on one side of rows 30, 32; integrated circuit 54 is identical to integrated circuit 66 and likewise represents one of six identical circuits on the other side of rows 30, 32. Each integrated circuit has fifth-four cells to serve fifty-four fingers 52, 57. Thus the twelve circuits are able to serve all 648 of fingers 52, 57.

Integrated circuitry 66 includes a shift register 110 having a set of cells 112. Each cell 112 includes a transistor 114 whose emitter is grounded, whose collector is connected to a particular one of the fingers 57, and whose base is controlled by the value of a bit stored in the cell. When the bit has one value, transistor 114 is driven to saturation so that the corresponding finger 57 is effectively grounded (actually the finter is drawn down to the saturation voltage, V_{sat}, of transistor 114, e.g., 0.3 volts).

When the bit has the opposite value, transistor 114 is off and the potential on the corresponding finger 57 is permitted to float.

Referring to Fig. 3, power supply and control logic 18 includes a bus power supply 120 capable of producing highly regulated voltages at two levels: a higher level for causing printing at a selected element (the higher level is selected so that the voltage drop across a given element will drive current sufficient to cause the element to heat to a temperature which causes marking) and a lower level for driving the non-printing buses (the lower level is selected so that the voltage drop across a given element will not be sufficient to cause printing). Bus power supply 120 is connected via high and low voltage lines 122, 124 to power-to-buses switching logic 126. Logic 126 has outputs connected to bus connection lines 41, 43, 45, 47 for delivering the supply voltages, and has its input connected via control signal line 128 to control logic 130 for receiving signals which control the switching of the supply voltages to bus lines at any given time.

Control logic 130 is also connected via control and data lines 132, 134 to bit stream switching logic 136 for delivering, respectively, streams of bits corresponding to dots to be printed, and related timing control signals which synchronize the operation of the integrated circuits 54, 66 with the powering of buses 46, 50, 60, 64. Logic 136 is connected via lines 49, 51 to circuits 54, 66 for carrying the bit streams and the timing control signals.

Control logic 130 is also connected via control signal line 17 to paper driver 16 and via control signal line 138 to paper drive power supply 140 to trigger the repositioning of the paper to each successive position at the proper time. The output of supply 140 is connected via power line 19 to paper driver 16.

Finally, control logic 130 is connected via control line 25 and data line 27 to the microprocessor (not shown) to receive the bit streams and commands directing it when to print.

Referring to Fig. 4, in one typical situation, during printing, bus 46 is driven to the higher first voltage level (V_A) and buses 50, 60, 64 are driven to the lower second voltage level (V_B). Each resistance labelled R_M represents a printing element which is intended to be heated to print. R_{MM} represents heating elements which are not intended to be heated to print but which are connected to the same gounding finger as an R_M element. R_{NN} represents a heating element which is not intended to be heated to print but is connected to the bus which is being driven to voltage V_A. R_N represents heating elements connected between the same grounding finger as an R_{NN} element, and one of the buses driven to voltage V_B. With transistors 71, 73 turned on, fingers 75, 77 are at a third voltage level V_{sat}.

Thus, V_A must be high enough so that each R_M heats sufficiently to cause printing from a voltage drop of $V_A - V_{sat}$ across these resistors. V_B must be low enough so that each R_{MM} does not heat sufficiently to print with a voltage drop of $V_B - V_{sat}$ across it, and so that each R_{NN} and R_N does not print from a voltage drop of $V_B - V_A$ across each network consisting of R_{NN} in series with three parallel R_N elements.

Subject to those constraints, it is desirable to set V_B at a level which minimizes the total power dissipated in the R_{MM}, R_{NN} and R_N elements.

The voltages across the various resistors are as follows:

$$VR_M = V_A - V_{sat}$$
$$VR_{NN} = 3/4(V_A - V_B)$$
$$VR_N = 1/4(V_A - V_B)$$
$$VR_{MM} = V_B - V_{sat}$$

The minimum power dissipation will occur when $VR_{MM} = VR_{NN}$, i.e., when

$$V_B - V_{sat} = 3/4(V_A - V_B)$$

or

$$V_B = 3/7V_A + 4/7V_{sat}$$
$$= 3/7(V_A - V_{sat}) + V_{sat}$$

Thus, V_B should be set at 3/7 of the voltage across the printing resistors (i.e., 3/7 of $V_A - V_{sat}$) plus the saturation voltage (V_{sat}), so that

$$VR_M = V_A - V_{sat}$$
$$VR_{NN} = 3/7(V_A = V_{sat})$$
$$VR_N = 1/7(V_A - V_{sat})$$
$$VR_{MM} = 3/7(V_A - V_{sat})$$

With that value of V_B the power dissipated in each of the non-printing elements is $3/7 \times 3/7 = 9/49 = 18.2\%$ of the power dissipated in each of the printing elements.

To print a desired pattern of dots, paper 12 is moved to a succession of fixed positions relative to stripes 30, 32. At each position, power is applied to those elements 36, 38 which need to be heated in order to mark desired dots at corresponding locations on the paper. Power is applied in four stages. In each stage, V_A is applied to a particular one of the buses 46, 50, 60, 64, while V_B is applied to the remaining three buses. For example, V_A is applied to bus 46 and V_B is applied to buses 50, 60, 64. Under these circumstances, only half of the elements 36 on stripe 30, (i.e., those which are connected to bus 46) can be selected to heat to print corresponding dots. A particular one of those elements heats to print by having integrated circuits 54, 66 connect to ground the finger 52, 57 which leads from the element to be heated, thus establishing $V_A - V_{sat}$ across the element. For example, in Fig. 2, element 70 can be heated to print a corresponding dot by grounding finger 100 to establish a current path (indicated by arrow 102). Appropriate bits are loaded into integrated circuits 54, 66 to cause, while V_A is being applied to bus 46, the desired elements to be grounded and the others to remain floating.

Many unwanted parasitic electrical paths exist along the length of head 14 tending to drive buses 50, 60, 64 to V_A, for example the path (arrow 104) from bus 46 via two elements to bus 50. Were bus 50 actually driven to V_A, then element 72, being connected between V_A and V_{sat}, would erroneously print a dot. However, because V_B applied to bus 50 is regulated to be constant (notwithstanding parasitic paths such as 104), bus 50 cannot be driven to V_A. Because V_B is insufficient to cause printing by element 72, no erroneous printing occurs.

In the second stage of printing, the paper remains in the same position, V_A is applied to bus 50, V_B is applied to buses 46, 60, 64 and appropriate ones of fingers 52 and 57 are grounded to cause printing by desired ones of that half of the elements on row 30, which are connected to bus 50.

A similar procedure is followed in the third and fourth stages with the V_A being applied first to bus 60, then to bus 64. Thus, in the course of the four stages, any of the elements on rows 30, 32 can be caused to print.

Next the paper is moved along axis 42 by a distance equal to the width of row 30 to a new position, at which the four printing stages are again repeated, this time with an updated set of fingers 52, 57 being grounded in order to print desired dots at the new paper position.

The paper is the moved to a succession of new fixed positions, at each of which the four printing stages are repeated. Because the elements on rows 30, 32 are staggered with respect to each other, dots can be printed at all desired places on the page. The loading of bits into the shift registers, the switching of voltages onto buses 46, 50, 60, 64, and the advance of the paper to successive positions, are all synchronized by control signals delivered from power supply and control logic 130. The microprocessor to which the power supply and control logic 18 are connected is programmed to provide the needed bit patterns for integrated circuits 54, 66 based on the characters or graphic symbols to be printed.

By holding the non-printing buses to a fixed second voltage level insufficient for causing marking, no diodes are required to counteract the parasitic voltages which could otherwise appear on the non-printing buses. Eliminating the diodes reduces the design and manufacturing costs and improves the reliability of the head, by making more space available on the head substrate. The availability of space also permits using four buses, two on each side of the elements. Four buses enables using two rows of printing elements, each served by two of the buses. By having each sink conductor connect to both rows, each sink conductor can serve four elements. Having alternate ones of the sink conductors lead out to different sides of the element rows reduces the density of the required switching circuitry on the substrate, thus reducing design and manufacturing complexity and cost, and improving reliability. Using four buses permits four-stage printing which reduces the peak power load. Offsetting the two rows of elements with respect to each other assures that every location on a page can be printed.

Other embodiments are within the following claims. For example, more than two rows of elements could be used, with the number of buses being double the number of rows.

Claims

1. A thermal print head comprising a first continuous stripe (30) of material along which is defined a first row of electrical heating elements (36, 38), circuitry (54, 66) connected to the elements for heating selectively the elements to cause marking in corresponding regions of a surface to be printed on, and a second continuous stripe (32) of material along which is defined a second row of electrical heating elements (36, 38) connected to said circuitry (54, 66) characterized in that the first row of heating elements is configured, such that, when two adjacent elements are heated, a non-marked gap appears between the resulting two marked regions on the surface, and the second row of heating elements is configured such that, when the surface to be printed on is relocated (in a direction perpendicular to the rows) to a position where the marked regions lies adjacent the second row of heating elements, an element of the second row can be heated to cause marking in the gap.

2. The thermal print head of claim 1 wherein said circuitry (54, 66) comprises leads (22, 48, 52, 57, 58, 62) that overlap the continuous stripes (30,

32) to define overlap areas, the elements (36, 38) being defined between the locations where successive leads overlap the stripes, and the elements and the spaces having the same lengths in the direction of the length of the rows.

3. The thermal print head of claim 2 further comprising buses (46, 50; 60. 64) for delivering power to the elements, each of said buses being connected in common to a plurality of the elements,

a power source (120) for applying to one of the buses a first voltage level sufficient, when applied to one of said elements to which the bus is connected, to cause marking of a surface to be printed on,

the connections between said buses and said elements being arranged to define both an electrical path (102) from the one bus (46, 50) to the one element (36, 38) to cause the marking, and unwanted electrical paths from the one bus via the elements to other of said buses (60, 64),

the power source (120) being arranged to hold the other buses (60, 64) at a fixed second voltage level insufficient for causing said marking.

4. A thermal print head according to any of claims 1 to 3 comprising

at least two parallel rows of electrical heating elements, buses (46, 50) for delivering power to the heating elements (36, 38), each bus being connected in common to a plurality of the elements,

a power source (120) for applying to one bus (46) of the buses (46, 60) a first voltage level sufficient, when applied to one element to which said bus is connected, to cause marking of a surface to be printed on,

the connections between the buses and the elements being arranged to define both an electrical path (102) from the one bus (46) to the one element (36) to cause the marking, and unwanted electrical paths from the one bus (46) via the elements to the other bus (60), characterized in that

the power source (120) being arranged to hold said other bus (60) at a fixed second voltage level insufficient for causing the marking.

5. The thermal print head of claim 4 further comprising conductors for selectively connecting each element to a predetermined third voltage level, the voltage difference between the first and third voltage levels being sufficient to cause the marking, the voltage difference between the second and third voltage levels being insufficient to cause the marking, and the voltage difference between the first and second voltage levels being insufficient to cause the marking.

6. The thermal print head of claim 5 wherein the second voltage level is lower than the first voltage level and is selected to have a value, relative to the first voltage level, which minimizes the aggregate power loss in said heating elements (36, 38).

7. The thermal print head of claim 6 wherein the second voltage level is held at a value equal to the third voltage level plus 3/7 of the difference between the first voltage level and the third voltage level.

Patentansprüche

1. Thermischer Druckkopf, mit einem ersten durchgehenden Werkstoff-Streifen (30), entlang dem eine erste Reihe elektrischer Heizelemente (36, 38) ausgebildet ist, einer Schaltungsanordnung (54, 66), die mit den Elementen zu gezielten Aufheizen derselben verbunden sind, derart, daß in entsprechenden Bereichen einer zu bedruckenden Fläche eine Marke erzeugbar ist, und einem zweiten durchgehenden Werkstoff-Streifen (32), entlang dem eine zweite Reihe elektrischer Heizelemente (36, 38) ausgebildet ist, die mit der Schaltungsanordnung (54, 66) verbunden sind, dadurch gekennzeichnet, daß die erste Reihe Heizelemente so konfiguriert ist, daß bei Aufheizen von zwei benachbarten Elementen zwischen den sich ergebenden zwei markierten Bereichen auf der Fläche einen nicht markierte Lücke entsteht, und die zweite Reihe Heizelemente so konfiguriert ist, daß, wenn die zu bedruckende Fläche (in Richtung rechtwinklig zu den Reihen) neu positioniert wird in einer Stellung, in der die markierten Bereiche in der Nähe der zweiten Reihe Heizelemente angeordnet sind, ein Element der zweiten Reihe aufgeheizt werden kann, um eine Markierung in der Lücke hervorzurufen.

2. Thermischer Druckkopf nach Anspruch 1, bei dem die Schaltungsanordnung (54, 66) Leitungen (22, 48, 52, 57, 58, 62) aufweist, welche die durchgehenden Streifen (30, 32) überlappen, derart, daß Überlappungsbereiche ausgebildet sind, wobei die Elemente (36, 38) zwischen den Orten ausgebildet sind, an denen aufeinanderfolgende Leitungen die Streifen überlappen, und die Elemente und die Lücken in Längsrichtung der Reihen von derselben Länge sind.

3. Thermischer Druckkopf nach Anspruch 2, welcher ferner umfaßt

Busleitungen (46, 50; 60, 64) für die Stromzuführung zu den Elementen, wobei jede der Busleitungen an eine Vielzahl von Elementen gemeinsam angeschlossen ist,

eine Stromquelle (120) zum Anlegen an eine der Busleitungen eines erste Spannungspegels, welcher ausreicht, um bei Anlegen an eines der Elemente, mit dem die Busleitung verbunden ist, eine Markierung einer zu bedruckenden Fläche hervorzurufen,

wobei die Verbindungen zwischen den Busleitungen und den Elementen so ausgelegt sind, daß sowohl ein elektrischer Pfad (102) von der einen Busleitung (46, 50) zu dem einen Element (36, 38) ausbildbar ist, um die Markierung hervorzurufen, als auch unerwünschte elektrische Pfade von der einen Busleitung über die Elemente zur anderen der Busleitungen (60, 64),

dabei die Stromquelle (120) so ausgelegt ist, daß sie die anderen Busleitungen (60, 64) auf einem festen zweiten Spannungspegel hält, welcher nicht ausreicht, um die genannte Markierung hervorzurufen.

4. Thermischer Druckkopf nach einem der Ansprüche 1 bis 3, welcher umfaßt

wenigstens zwei parallele Reihen elektrischer Heizelemente, Busleitungen (46, 50) für die Stromzuführung zu den Heizelementen (36, 38), wobei jede Busleitung an eine Vielzahl der Elemente gemeinsam angeschlossen ist,

eine Stromquelle (120) zum Anlegen an eine Busleitung (46) der Busleitungen (46, 60) eines ersten Spannungspegels, welcher ausreicht, um bei Anlegen an ein Element, mit dem die genannte Busleitung verbunden ist, eine Markierung einer zu bedruckenden Fläche hervorzurufen,

wobei die Verbindungen zwischen den Busleitungen und den Elementen so ausgelegt sind, daß sowohl ein elektrischer Pfad (102) von der einen Busleitung zu dem einen Element (36) ausbildbar ist, um die Markierung hervorzurufen, als auch unerwünschte elektrische Pfade von der einen Busleitung (46) über die Elemente zur anderen Busleitung (60), dadurch gekennzeichnet, daß

die Stromquelle (120) so ausgelegt ist, daß sie die andere Busleitung (60) auf einem festen zweiten Spannungspegel hält, der nicht ausreicht, um die Markierung hervorzurufen.

5. Thermischer Druckkopf nach Anspruch 4, welcher ferner umfaßt Leiter zum gezielten Anschließen jedes Elementes an einen im voraus festgelegten dritten Spannungspegel, wobei die Spannungsdifferenz zwischen dem ersten und dem dritten Spannungspegel ausreicht, um die Markierung hervorzurufen, die Spannungsdifferenz zwischen dem zweiten und dem dritten Spannungspegel nicht ausreicht, um die Markierung hervorzurufen, und die Spannungsdifferenz zwischen dem ersten und dem zweiten Spannungspegel nicht ausreicht, um die Markierung hervorzurufen.

6. Thermischer Druckkopf nach Anspruch 5, bei dem der zweite Spannungspegel niedriger als der ersten Spannungspegel ist und, bezogen auf den ersten Spannungspegel, mit einem Wert gewählt ist, der die Gesamtverlustleistung in den Heizelementen (36, 38) so gering wie möglich hält.

7. Thermischer Druckkopf nach Anspruch 6, bei dem der zweite Spannungspegel auf einem Wert gleich dem dritten Spannungspegel plus 3/7 der Differenz zwischen dem ersten und dem dritten Spannungspegel gehalten ist.

Revendications

1. Tête d'impression thermique, comprenant une première bande continue (30) de matériau, le long de laquelle une première rangée d'éléments chauffants électriques (36, 38) est définie, un ensemble de circuits (54, 66) raccordé aux éléments en vue du chauffage sélectif des éléments afin de créer un marquage dans des zones correspondantes d'une surface à imprimer, et une deuxième bande continue (32) de matériau, le long de laquelle est définie une deuxième rangée d'éléments chauffants électriques raccordés audit ensemble de circuits (54, 66), caractérisée en ce que la configuration de la première rangée d'éléments chauffants est telle que, lors du chauffage de deux éléments adjacents, un interstice sans marque apparaît entre les deux zones marquées obtenues sur la surface, et la configuration de la deuxième rangée d'éléments chauffants est telle que, lors du positionnement de la surface à imprimer (en la déplaçant perpendiculairement aux rangées) dans une nouvelle position dans laquelle les zones marquées se trouvent au droit de la deuxième rangée d'éléments chauffants, un élément de la deuxième rangée peut être chauffé afin de produire un marquage dans l'interstice.

2. Tête d'impression thermique selon la revendication 1, dans laquelle ledit ensemble de circuits (54, 66) comprend des lignes d'amenée (22, 48, 52, 57, 58, 62) qui chevauchent les bandes continues (30, 32) de sorte que des zones de chevauchement sont formées, les éléments (36, 38) étant définis entre les endroits où des lignes successives chevauchent les bandes, et les éléments et les interstices ont les mêmes longueurs, prises dans la direction longitudinale des rangées.

3. Tête d'impression thermique selon la revendication 2, comprenant en outre

des bus (46, 50; 60, 64) pour l'alimentation en courant des éléments, chacun desdits bus étant raccordé, en commun, à une pluralité des éléments,

une source de courant (120) servant à appliquer, à l'un des bus, un premier niveau de tension qui, lorsqu'il est appliqué à l'un desdits éléments auquel le bus est raccordé, est suffisant pour produire le marquage d'une surface à imprimer, les connexions entre lesdits bus et lesdits éléments étant réalisées de manière à définir aussi bien une voie électrique (102) à partir de l'un des bus (46, 50) vers l'un des éléments (36, 38) afin de produire le marquage, que des voies électriques non désirées à partir de l'un des bus via les éléments vers l'autre des bus (60, 64),

la source de courant (120) étant aménagée de manière à maintenir les autres bus (60, 64) à un deuxième niveau de tension fixe qui ne suffit pas à produire ce marquage.

4. Tête d'impression thermique selon l'une quelconque des revendications 1 à 3, comprenant

deux rangées parallèles, au moins, d'élément chauffants électriques,

des bus (46, 50) d'alimentation en courant des éléments chauffants (36, 38), chacun des bus étant raccordé, en commun, à une pluralité des éléments,

une source de courant (120) servant à appliquer à un bus (46) des bus (46, 60) un premier niveau de tension qui, lorsqu'il est appliqué à un élément auquel ledit bus est raccordé, suffit à produire un marquage d'une surface à imprimer,

les connexions entre les bus et les éléments étant réalisées de manière à définir aussi bien une voie électrique (102) à partir de ce même bus (46) vers ce même élément (36) afin de produire le marquage, que des voies électriques non désirées à partir de ce même bus (46) via les éléments vers

l'autre bus (60), caractérisée en ce que

la source de courants (120) est aménagée de manière à maintenir cet autre bus (60) à un deuxième niveau de tension fixe qui ne suffit pas à produire le marquage.

5. Tête d'impression thermique selon la revendication 4, comprenant en outre

des conducteurs servant au raccordement sélectif de chaque élément à un troisième niveau de tension prédéterminé, la différence de tension entre les premier et troisième niveaux de tension étant suffisante pour produire le marquage, la différence de tension entre les deuxième et troisième niveaux de tension ne suffisante pas pour produire le marquage, et la différence de tension entre les premier et deuxième niveaux de tension ne suffisant pas pour produire le marquage.

6. Tête d'impression thermique selon la revendication 5, dans laquelle le deuxième niveau de tension est inférieur au premier niveau de tension et est choisi pour avoir une valeur, par rapport au premier niveau de tension, qui réduit au minimum la dissipation de puissance totale dans lesdits éléments chauffants (36, 38).

7. Tête d'impression thermique selon la revendication 6, dans laquelle le deuxième niveau de tension est maintenu à une valeur égale au troisième niveau de tension plus les 3/7 èmes de la différence entre le premier niveau de tension et le troisième niveau de tension.

Fig. 1

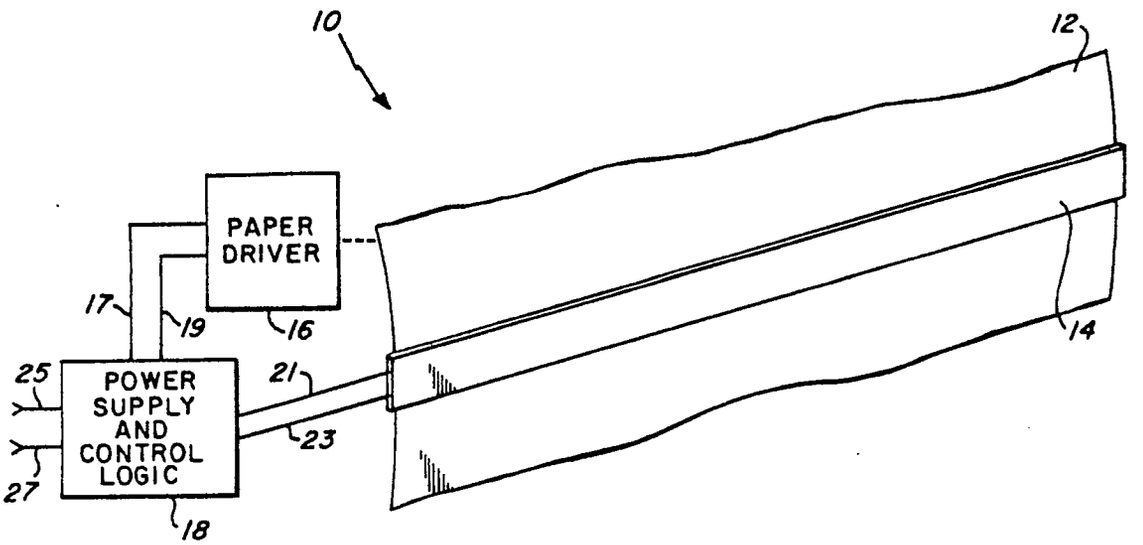

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PAPER DRIVER
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POWER SUPPLY AND CONTROL LOGIC
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Fig. 2

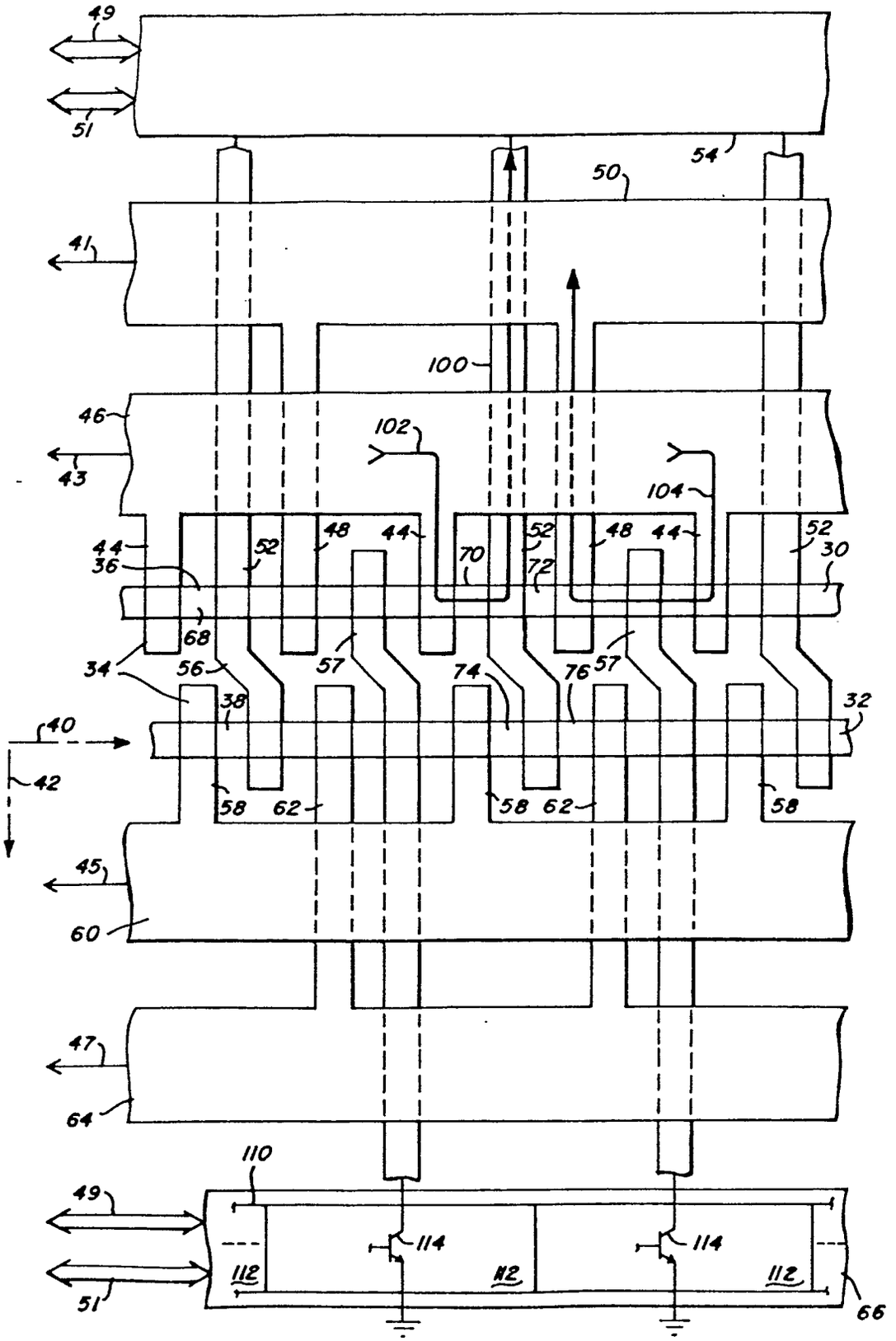

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100
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102
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104
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112
66

Fig.3

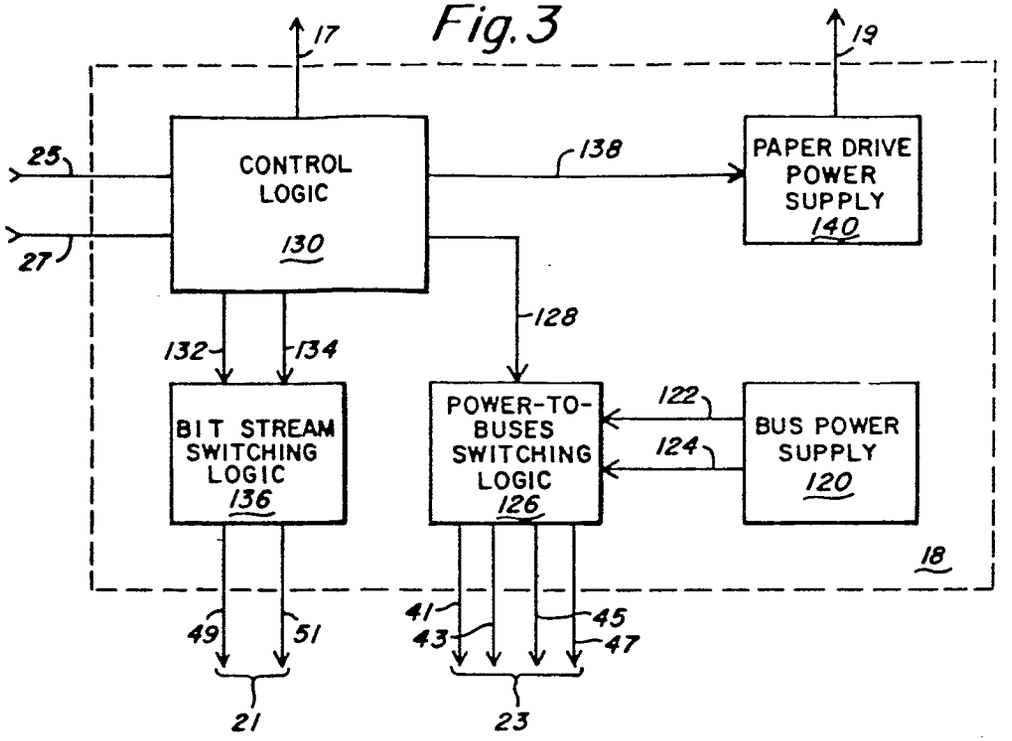
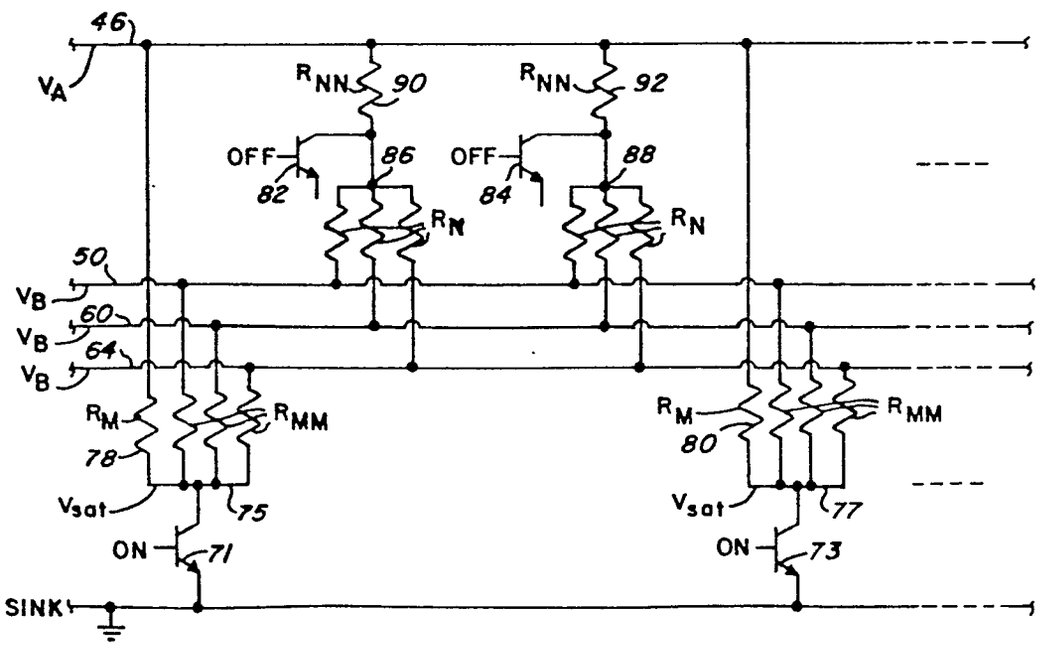

17
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25
27
CONTROL LOGIC
130
138
PAPER DRIVE POWER SUPPLY
140
128
132
134
BIT STREAM SWITCHING LOGIC
136
POWER-TO-BUSES SWITCHING LOGIC
126
122
124
BUS POWER SUPPLY
120
18
49
51
21
41
43
45
47
23

Fig.4


46
V_A
R_{NN} 90
R_{NN} 92
OFF 86
OFF 88
82
84
R_N
R_N
50
V_B
60
V_B
64
V_B
R_M
R_{MM}
78
R_M
80
R_{MM}
V_{sat}
75
V_{sat}
77
ON 71
ON 73
SINK