Sept. 9, 1969 J. L. JANNING 3,466,423

THERMAL HALF-SELECT PRINTING MATRIX

Filed June 19, 1967

FIG. 1

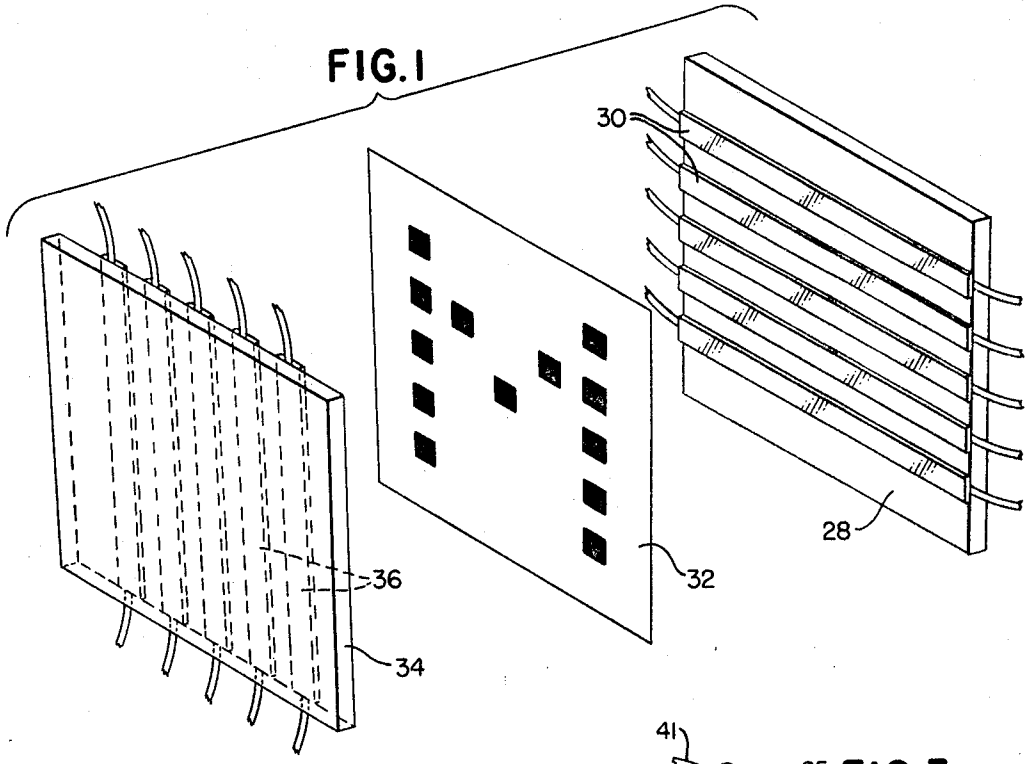


FIG. 2

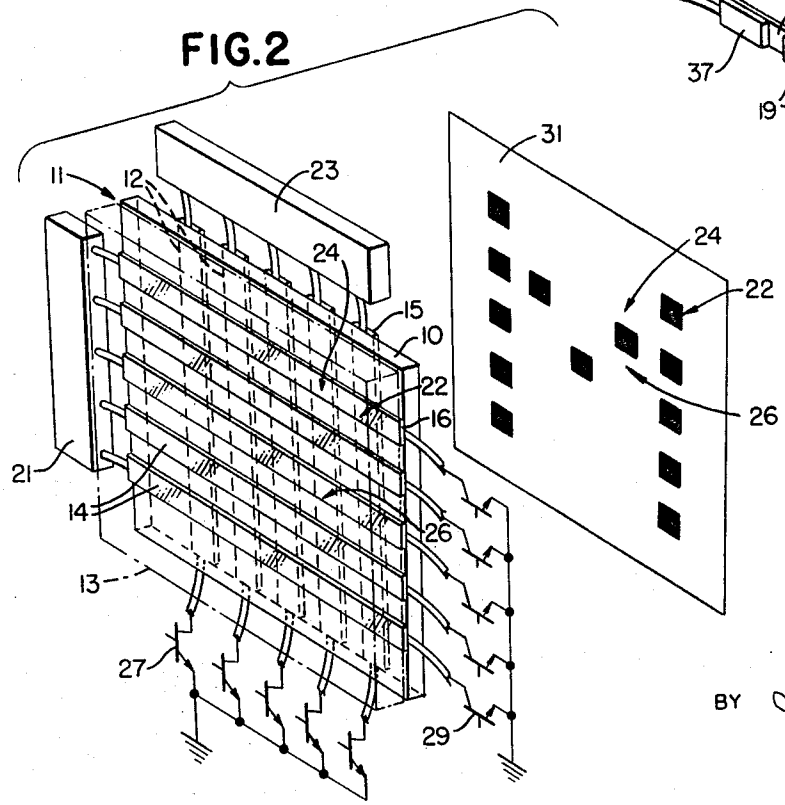
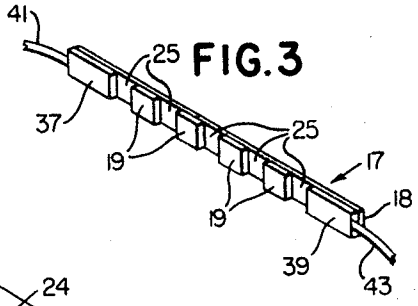


FIG. 3



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THERMAL HALF-SELECT PRINTING MATRIX

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ABSTRACT OF THE DISCLOSURE

Thermal half-select printing matrices in which printing on an adjacent heat-sensitive material occurs only at those matrix points which have coincident electrical current flowing through crossing electrically resistive thermal printing conductors which define those points.

Background of the invention

Full-select thermal printing matrices employed in the prior art must have an isolation diode for each electrical selection conductor that is employed in order to prevent "sneak" currents and to isolate one matrix element from another. The thermal half-select printing matrices of the present invention eliminate the necessity of supplying an isolation diode for each electrically resistive thermal printing conductor of a thermal printing matrix.

Summary

Thermal half-select printing is accomplished by coincident current energization of electrically resistive thermal printing elements.

Brief description of the drawing

FIGURE 1 is a perspective view of one embodiment of the present invention, in which row and column electrically resistive thermal printing conductors are located on separate substrates.

FIGURE 2 is a perspective view of another embodiment of the present invention, in which row and column electrically resistive thermal printing conductors are located on a common substrate.

FIGURE 3 is a perspective view of an alternate electrically resistive thermal printing conductor.

Description of the preferred embodiments

The thermal half-select printing matrices of the present invention are constructed for use with thermally sensitive record material. In the embodiment of FIGURE 2, a thin electrically insulating substrate **10**, which may be of any electrically insulating material, such as silicon dioxide, which is not subject to rapid heat diffusion from a heated point on the substrate, is employed. The thin electrically insulating substrate **10** should be on the order of one thousandth of an inch thick. The complete thermal printing member **11** is then mounted on a rigid support board **13**.

Electrically resistive thermal printing conductors which are on the order of 16 thousandths to 70 thousandths of an inch wide and on the order of 4 millionths of an inch thick, and which are composed of an electrically resistive material such as tin oxide, Nichrome, rhenium, tantalum, or other such materials, are aligned into columns **12** on one side of the substrate **10** and into rows **14** on the other side of the substrate **10**. When the heat-sensitive side of a thermally sensitive record material **31** is brought near the substrate **10**, printing may be accomplished at a matrix location, such as **22**, by coincident current energization of the crossing row and column conductors that are associated with that location. Coincident electrical current is supplied by the current supply means **21** and **23** and the

selection grounding transistors **27** and **29**, which are selectively saturated when supplied with positive voltage selection signals on their bases. For example, if an electrical current is passed through the column conductor **15** coincidentally with an electrical current through the row conductor **16**, the radiated energy at the matrix location **22** due to the current in each of the conductors **15** and **16** will add, and, consequently, printing will occur on the thermally sensitive paper **31** at this location if the thermal threshold of the thermally sensitive paper is exceeded. Energization of only one conductor will not produce sufficient energy at a matrix location to exceed the thermal threshold of the thermally sensitive paper **31**. At other points of the matrix, such as the matrix points **24** and **26**, where only the current through either a row conductor or a column conductor generates energy, the thermal printing threshold of the heat-sensitive paper is not exceeded, and, therefore, printing does not occur at these points.

The thermal printing paper **31** may be placed in proximity with the exposed side of the electrically insulating film substrate **10**. The optimum operating characteristics are found to exist when the heat-sensitive paper **31** is positioned in its thermal printing position and the current through a column conductor is increased until printing occurs as the result of energy through the column conductor only. The current through the column conductor is then reduced by approximately 10%. The same procedure is then followed for determining the optimum operating point of a row conductor.

FIGURE 1 shows another embodiment of the present invention, in which row conductors **30** are secured on one side of an electrically insulating substrate **28**. The substrate **28** is then placed behind the non-thermally sensitive side of the thermally sensitive paper **32**. Column conductors **36** of an electrically resistive material are secured on one side of another electrically insulating substrate **34**. The substrate **34** is positioned on the front, or heat-sensitive, side of the thermally sensitive paper **32**. As in the embodiment of FIGURE 2, the row and column conductors may be interchanged if desired. The same procedure for obtaining the optimum operating characteristics which was described in conjunction with the embodiment of FIGURE 2 may also be employed in connection with the embodiment of FIGURE 1.

FIGURE 3 shows an alternate electrically resistive conductor **17**, which may replace the row conductors or the column conductors of the embodiments of FIGURES 1 and 2. This conductor **17** consists of alternate areas **19** of an electrically conductive material, such as copper or gold, which are deposited over an electrically resistive substrate material **18**, such as tin oxide, etc. The deposited conductive material **19** reduces the resistance along portions of the conductor **17** in which no print is desired; therefore the total energy loss of the conductor **17** is reduced, and, in addition, printing is more accurately confined to the desired printing areas **25**. External electrical connections are made to the conductive areas **37** and **39** by the conductive leads **41** and **43**, respectively.

What is claimed is:

1. A thermal printing device for printing on a thermally-sensitive record material, comprising:

(a) a first set of electrically resistive printing elements, and

(b) a second set of electrically resistive printing elements crossing the first set of printing elements, to form a matrix of thermal printing locations at those portions of the printing elements which intersect, and

(c) means to selectively supply electrical current through printing elements of the first and second sets of electrically resistive printing elements, to achieve printing on a thermally-sensitive record material that is positioned adjacent the matrix of thermal printing

locations in the vicinity of those thermal printing locations which are formed by an intersecting portion of a printing element of the first set and an intersecting portion of a printing element of the second set when both of the crossing printing elements at a thermal printing location are coincidentally conducting current, wherein the electrically resistive printing elements of at least one of the sets of the printing elements each comprises an electrically conductive path of alternately arranged high-resistance portions and low-resistance portions, and the high-resistance portions define the thermal printing locations of the matrix.

2. A thermal printing device for printing on a thermally-sensitive record material, comprising:

(a) a first set of electrically resistive printing elements, and

(b) a second set of electrically resistive printing elements crossing the first set of printing elements, to form a matrix of thermal printing locations at those portions of the printing elements which intersect, and

(c) means to selectively supply electrical current through printing elements of the first and second sets of electrically resistive printing elements, to achieve printing on a thermally-sensitive record material that is positioned adjacent the matrix of thermal printing locations in the vicinity of those thermal printing locations which are formed by an intersecting portion of a printing element of the first set and an intersecting portion of a printing element of the second set when both of the crossing printing elements at a thermal printing location are coincidentally conducting current, wherein the first set of electrically resistive printing elements is mounted on one side of a non-conductive substrate, and the second set of electrically resistive elements is mounted on the other side of the non-conductive substrate.

3. A thermal printing device for printing on a thermally-sensitive record material, comprising:

(a) a first set of electrically resistive printing elements, and

(b) a second set of electrically resistive printing elements crossing the first set of printing elements, to form a matrix of thermal printing locations at those portions of the printing elements which intersect, and

(c) means to selectively supply electrical current through printing elements of the first and second sets of electrically resistive printing elements, to achieve printing on a thermally-sensitive record material that is positioned adjacent the matrix of thermal printing locations in the vicinity of those thermal printing locations which are formed by an intersecting portion of a printing element of the first set and an intersecting portion of a printing element of the second set when both of the crossing printing elements at a thermal printing location are coincidentally conducting current, wherein the first set of electrically resistive printing elements is mounted on one side of a non-conductive substrate, and the second set of electrically resistive elements is mounted on the other side of the non-conductive substrate, and the electrically resistive printing elements of at least one of the sets of the printing elements each comprises an electrically conductive path of alternately arranged high-resistance portions and low-resistance portions, and the high-resistance portions define the thermal printing locations of the matrix.

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