

[54] THERMAL PRINTING HEAD
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[51] Int. Cl. H05b 1/00
[58] Field of Search 219/216, 538, 543, 552; 346/76 R; 40/28 R; 340/166 EL

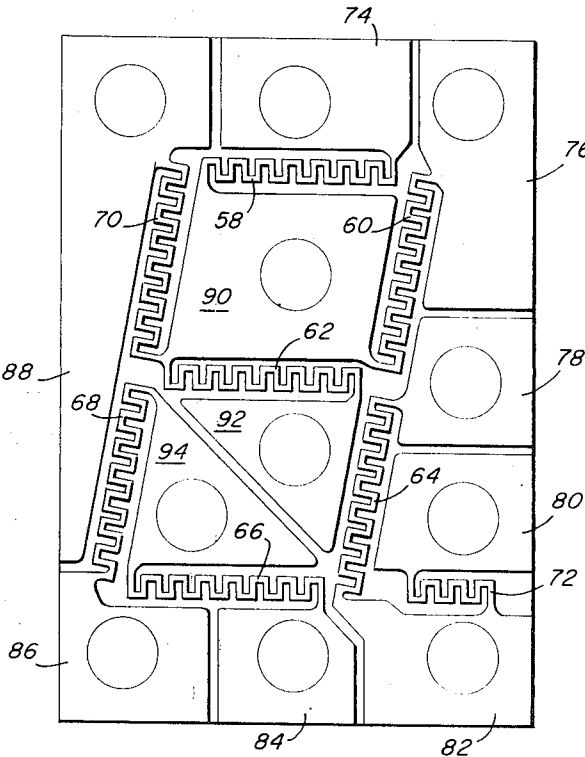
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[57] ABSTRACT

A thermal printing head comprises a vitreous plate through which a plurality of wires extend, the forward face, including the free extremities of the wires, constituting a planar continuum, and a plurality of vapor deposited sections selectively extending between selected free extremities of wires. The arrangement is such that the thermal coefficient of expansion of the wires and the vitreous plate are alike so that permanent integration of the wires and the plate is effected and bonding of the wires to the vapor deposited sections is assured.

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10 Claims, 5 Drawing Figures



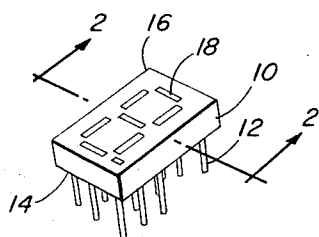


FIG. 1

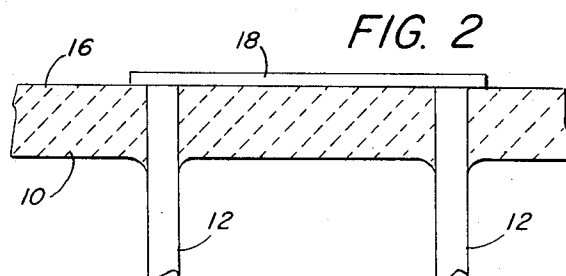


FIG. 2

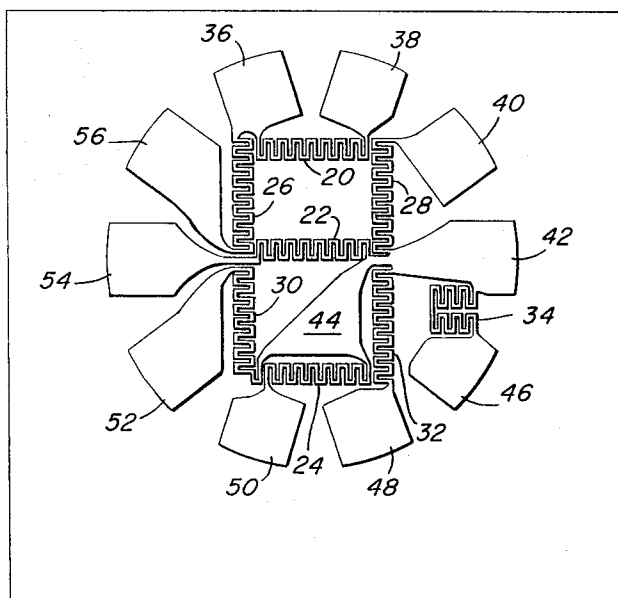
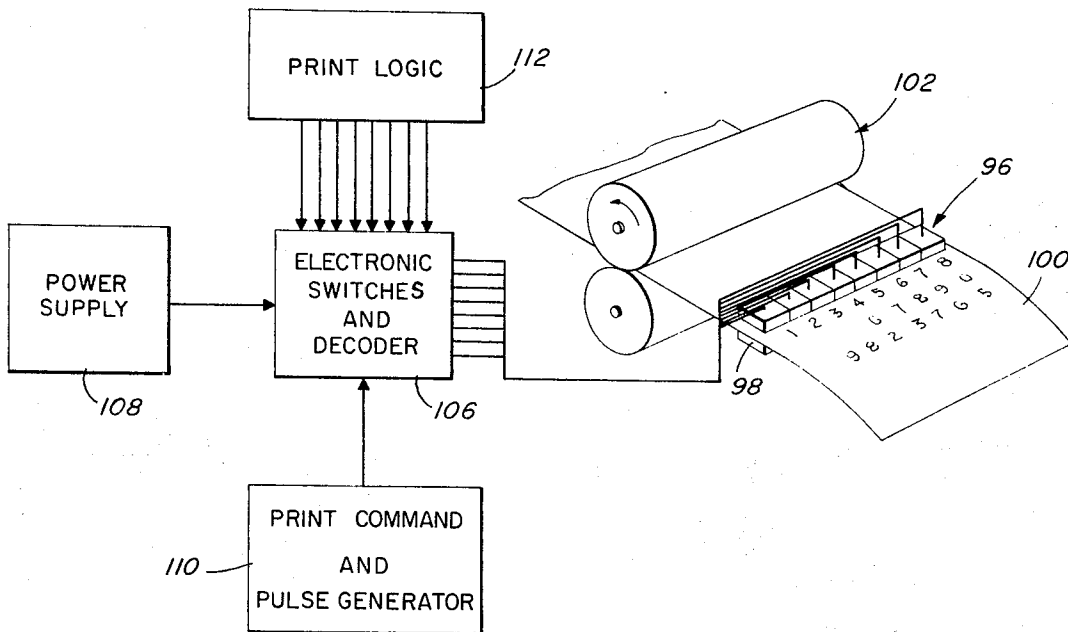
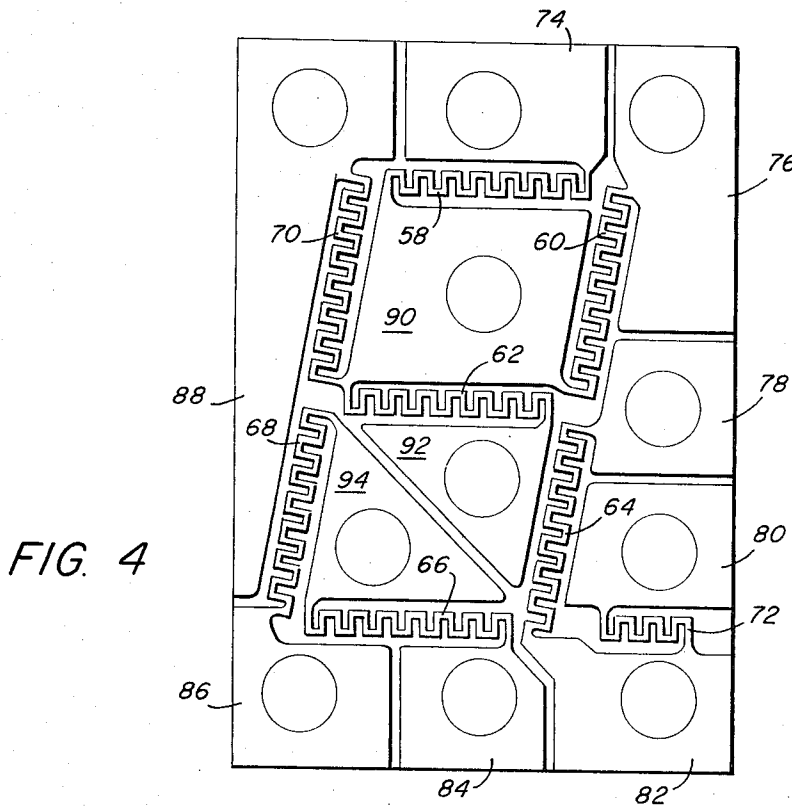


FIG. 3

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THERMAL PRINTING HEAD

DETAILED DESCRIPTION

The present invention relates to thermal printing heads of the type that are capable of producing characters, symbols, or the like in a heat sensitive paper and, more particularly, to a thermal print head comprising a vitreous substrate, a series of electrically resistive sections thereon and a series of electrical leads therethrough. Difficulties have been encountered in connection with unduly rapid wear of the electrically resistive elements, adequacy of the substrate as a heat sink for enabling repetition of the printing cycle, and accumulation of dust in interstices of the print head as a result of abrasion.

The object of the present invention is the provision of a novel printing head in which a vitreous plate support, a plurality of electrically resistive elements, and a plurality of electrical lead elements present a totally integrated planar continuum for contact with a heat sensitive paper, by which friction, abrasion and dust are minimized, risk of mechanical failure is decreased, and the resistive elements are sufficiently thin to enable very rapid rise and fall times thermally with respect to input electrical pulses. Preferably, the substrate is composed of glass and the leads are composed of a glass sealing alloy, such as Kovar sold by Westinghouse, so as to ensure an absolute seal between the substrate and the leads. Preferably, the resistive elements are composed of a chromium or tantalum metal, which combines good electrical resistivity and excellent mechanical wear resistance.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the product and system, together with their parts, components and interrelationships, which are set forth in the following disclosure the scope of which will be indicated in the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

Further details of the present invention will be understood in connection with the following detailed disclosure, together with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a printing element embodying the present invention;

FIG. 2 is an enlarged broken-away view, in cross-section, of the printing head of Fig. 1, the cross-section being along lines 2—2 of Fig. 1;

FIG. 3 is a resistive and conductive element pattern, typically associated with the printing element of Fig. 1;

FIG. 4 is an alternative resistive and conductive element pattern, typically associated with the printing element of Fig. 1; and

FIG. 5 is a schematic view of the system embodying a series of print heads of the type shown in Fig. 1.

DETAILED DESCRIPTION

Fig. 1 illustrates a preferred printing element of the present invention as comprising a substrate base 10, a plurality of electrical leads 12 which project from the rearward face 14 of the base to its forward face 16, and a plurality of electrically resistive elements 18 which are vapor deposited upon forward face 16. Resistive

elements 18, which are electrically discrete, include (1) three cross elements and four vertical elements that generally give the appearance of a figure 8 and (2) an additional element to the lower right of the figure 8 which constitutes a decimal point. As shown in FIG. 2, substrate 10 and leads 12 are perfectly flush with each other at front face 16 and leads 12 electrically communicate with certain of the vapor deposited sections 18. Preferably substrate base 10 is composed of a vitreous material, particularly glass, and metallic leads 12 are composed of a metal such as Kovar, which has substantially the same coefficient of expansion as glass. Typically, such a glass sealing alloy is a nickel-iron alloy containing, by total weight, 20% Ni, 17% Co, 0.2% Mn, and balance Fe. Face 16 is polished so as to produce a planar continuum. Preferably, the resistive elements, which are composed of a metal containing chromium or tantalum as its characteristic ingredient, ranges in thickness from 500 to 10,000 angstrom units. It will be appreciated that at the same time heat resistive elements 18 are formed, electrical communication between the resistive elements and leads 12 also is established.

The thermal print head consists of seven heat generating metallic resistive elements arranged in a Figure 8 configuration and a additional heat generating resistive element at the lower right of the Figure 8. By selectively energizing the heat resistive elements, all numbers from 0 to 9 can be generated and printed on a heat sensitive paper in contact with the print head. The vitreous substrate also serves as insulation for the heat elements. Thus the thermal print head consists of a glass plate with glass to metal sealed wires in connection with the heat resistive element that are formed by vacuum vapor deposition. The above method of forming heat generating character elements is not limited to the seven segment, numeric font shown. Other print characters can be formed to print alphanumeric symbols, letters and numbers. For example, a 16-line element would cover all numbers and letters and some symbols, and a 5 × 7 or 35 dot matrix would cover all types of numbers, letters and characters.

By virtue of the fact that the coefficient of expansion of kovar and the coefficient of glass are identical virtually, there is no physical interface between the kovar and the glass so that continued increase and decrease of heat in the vicinity of the kovar glass interface does not have the defect of breaking open the seal between the two. Preferably, the diameter of any kovar electrical lead ranges between 5 to 50 mils.

Fig. 3 illustrates a preferred pattern of resistive elements in accordance with the present invention. This pattern includes a plurality of resistive elements each in the form of a square wave, including horizontal elements 20, 22 and 24, vertical elements 26, 30, 32 and displaced element 34. Each of these elements, because of its extended length and small cross section, is capable of generating heat rapidly and intensely when subjected to an applied voltage. Control leads for the resistive elements are connected to wide area conductive elements 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56. Of these conductive elements, all are positioned externally of the figure 8 configuration, except conductive element 44 which is inside the figure 8 configuration. More specifically: resistive element 20 is connected

between conductive element 36, 38; resistive element 28 is connected between conductive elements 40, 42; resistive element 22 is connected between conductive element 54 on one side and conductive elements 42, 44 on the other side; resistive element 32 is connected between conductive elements 42, 48; resistive element 24 is connected between conductive elements 50, 48; resistive element 30 is connected between conductive elements 44, 52; and resistive element 26 is connected between conductive elements 56, 36. It will be appreciated that, with the proper logic circuitry, any number from 0 to 9 with or without a decimal point following, can be presented.

FIG. 4 illustrates an alternative vapor deposited pattern including horizontal resistive elements 58, 62, 66 and vertical resistive elements 60, 70, 64, 68, there being an additional adjacent resistive element 72 at the lower right. As in Fig. 3, each resistive element is in the form of a square wave, which has an extremely small cross-section whereby current flow establishes large heat generation. The electrical leads, which are 11 in number are connected to conductive sections, of which sections 74, 76, 78, 80, 82, 84, 86, 88 are external of the figure 8 configuration and sections 90, 92, 94 are internal of the figure 8 configuration. As shown: resistive element 60 is connected between conductive elements 76, 90; resistive element 64 is connected between conductive elements 78, 82; resistive element 58 is connected between conductive elements 74, 90; resistive element 64 is connected between conductive element 90, 92; resistive element 66 is connected between conductive elements 84, 94, resistive element 70 is connected between conductive elements 88, 90; and resistive element 68 is connected between conductive elements 94, 86.

Fig. 5 illustrates a system embodying a series 96 of print heads of the type shown in Fig. 1. Each of these print heads, one of which is shown at 98, is capable of creating numeric characters on a heat sensitive paper strip 100, which is advanced by feed rollers 102, and pressed against print heads 96 by a pressure pad 98. The character imparted depends upon an electronic circuit and power supply, which includes electronic switches and decoder 106 capable of imparting pulses in a train to selected conductive sections of the vapor deposited pattern on the print head. Electronic switches and decoder 106 are energized from a power supply 108, under the control of the print command and pulse generator 110 and is programmed by a print logic circuit 112. In practice the duration of a pulse ranges between 2 and 100 milliseconds. The foregoing arrangement has the advantages of solid state reliability, quiet operation, fast printing capability, and economical price. It is designed for application to such instruments as electronic desk calculators, computer output printers, electronically operated instruments, teletypewriter, digital display units, etc. Thermal printing eliminates the major mechanical and electromechanical parts of a printer, thus avoiding in mechanical complexity and reducing mechanical motion to paper advance only.

EXAMPLE

The following non-limiting example further illustrates the present invention:

Typically, the print head of Fig. 1 measures 0.200 inch high, 0.140 inch wide and 0.100 inch thick. The character dimension is 0.120 inch high and 0.080 inch wide. Electrical specifications are: resistance per segment — 100 ohms; power requirement — 18 volts; pulse duration — 20 milliseconds. Electrical contacts to segments are made by 11 leads on which three are common.

The present invention thus provides a novel thermal printer of improved solid state reliability, unusually quiet operation, unusually fast printing capability and unusually economical price. It is to be understood that all matter contained in the foregoing description and shown in the accompanying drawings are to be interpreted in an illustrative and not in a limiting sense.

What is claimed is:

1. A thermal print head comprising a vitreous plate, electrical leads extending through said plate from a rear face to a front face, said front face including the free extremities of said electrical leads and the surrounding regions of said vitreous plate disposed in a planar continuum, and a vapor deposited pattern on said front face composed of a metal containing, as its characteristic ingredient, a member selected from the class consisting of chromium and tantalum, said pattern including resistive elements of waveform configuration and conductive elements of solid configuration, selected ones of said resistive elements being connected between selected pairs of said conductive elements.

2. The thermal print head of claim 1 wherein said plate is composed of glass and said leads are composed of a nickel-iron alloy, said glass and said alloy having the same thermal coefficient of expansion.

3. The thermal print head of claim 1 wherein said free extremities of said selected ones of said electrical leads are in contact with selected ones of said conductive elements.

4. The thermal print head of claim 1 wherein the thickness of said resistive elements and said conductive elements ranges from 500 to 10,000 angstrom units.

5. The thermal print head of claim 1 wherein said resistive elements are eight in number and generally discrete from each other, being arranged in the form of a figure 8, together with a succeeding decimal point.

6. The thermal print head of claim 1 wherein certain of said conductive elements generally surround said resistive elements.

7. The thermal print head of claim 1 wherein certain of said conductive elements generally are surrounded by said resistive elements.

8. A thermal print head comprising a vitreous plate, electrical leads extending through said plate from a rear face to a front face, said front face including the free extremities of said electrical leads and the surrounding regions of said vitreous plate disposed in a planar continuum, and a vapor deposited pattern on said front face composed of a metal containing, as its characteristic ingredient, a member selected from the class consisting of chromium and tantalum, said pattern including resistive elements of waveform configuration and conductive elements of solid configuration, selected ones of said resistive elements being connected between selected pairs of said conductive elements, said plate being composed of glass and said

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leads being composed, of a nickel-iron alloy, said glass and said alloy having the same thermal coefficient of expansion, said free extremities of said selected ones of said electrical leads being in contact with selected ones of said conductive elements, the thickness of said resistive elements and said conductive elements ranges from 500 to 10,000 angstrom units, said resistive elements being eight in number, being generally discrete from each other and being arranged in the form of a

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figure 8, together with a succeeding decimal point.
9. The thermal print head of claim 8 wherein certain of said conductive elements generally surround said resistive elements.
10. The thermal print head of claim 8 wherein certain of said conductive elements generally are surrounded by said resistive elements.

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