# United States Patent [19]

**Taniguchi**

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[45] **Mar. 11, 1975**


[54] **THERMAL PRINTING HEAD**


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[73] Assignee: **Toyo Electronics Industry Corporation,** Ukyo-ku, Kyoto, Japan



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[30] **Foreign Application Priority Data**

Feb. 24, 1972 Japan ..... 47-22941

[52] **U.S. Cl.** ..... **219/216,** 219/543, 346/76 R

[51] **Int. Cl.** ..... **H05b 1/00**

[58] **Field of Search** ..... 219/216, 543, 388; 346/76 R



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,495,070 | 2/1970 | Zissen | 219/216 |
| 3,555,241 | 1/1971 | Carlsen | 219/216 |
| 3,684,858 | 8/1972 | Buck | 219/543 |
| 3,754,279 | 8/1973 | Valenti et al. | 346/75 R |



*Primary Examiner*—C. L. Albritton

*Attorney, Agent, or Firm*—Christensen, O'Connor, Garrison & Havelka



[57] **ABSTRACT**

A thermal printing head which comprises a block of an insulating material and a thermal printing multi-symbol unit provided on that surface of the block which is brought into contact with a sheet of thermally-sensitive recording paper or the like. The unit comprises a plurality of resistive elements each comprising a plurality of linear portions and so arranged that selective combination of the elements or portions thereof produces different symbols to be printed. A common lead connects one end of each of the resistive element linear portion to one terminal of a source of energy while different leads selectively connect the opposite ends of the linear portions to the opposite end of the source to effect selective heating of the linear portions to provide a desired symbol.


**14 Claims, 12 Drawing Figures**

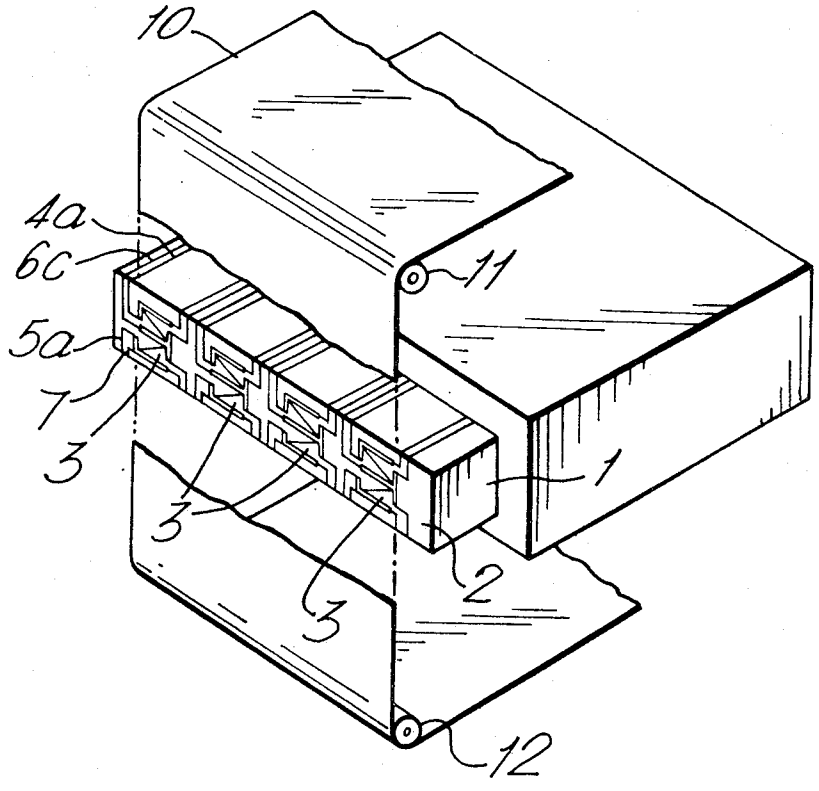


Fig. 1.

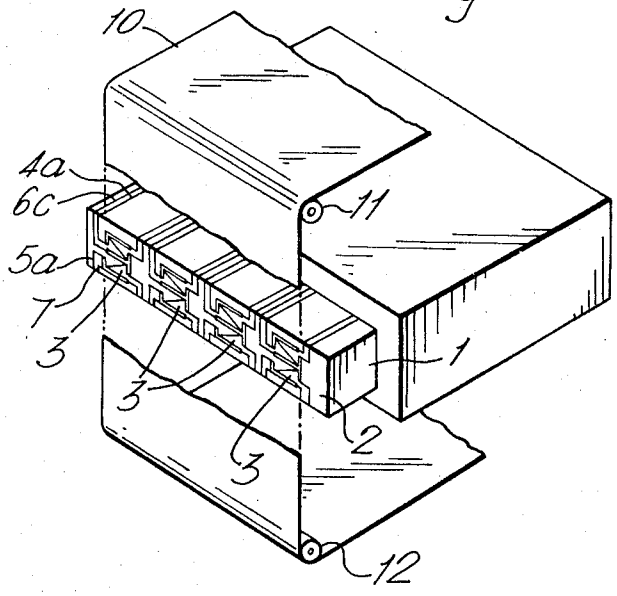



Fig. 2.

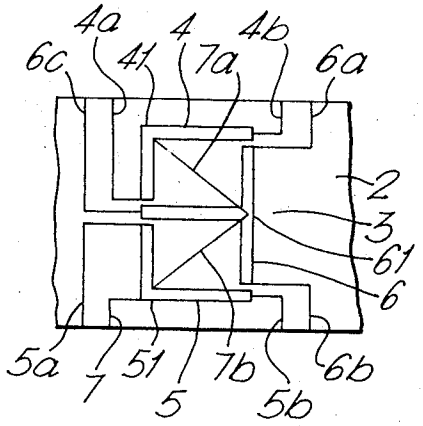


FIG. 3A

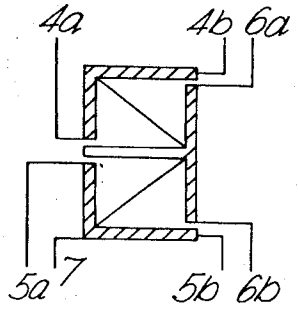



FIG. 3B

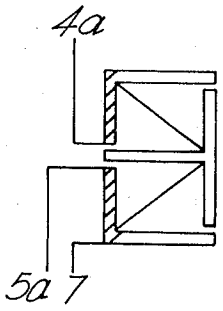



FIG. 3C

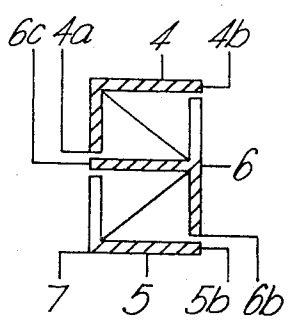



FIG. 3D

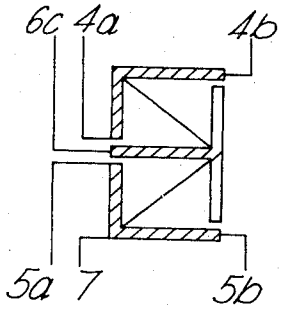



FIG. 3E

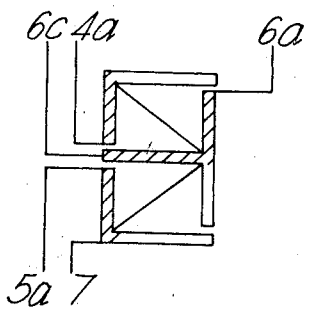



FIG. 3F

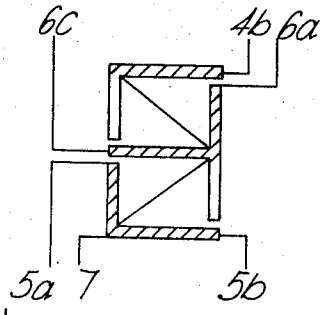



FIG. 3G

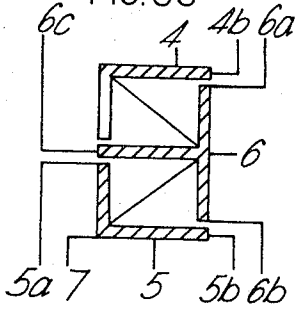



FIG. 3H

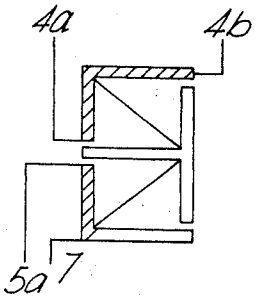



FIG. 3I

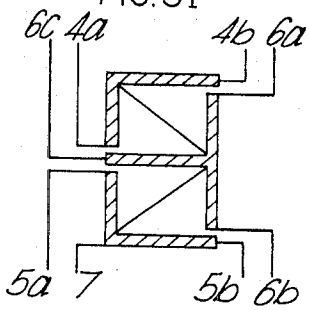
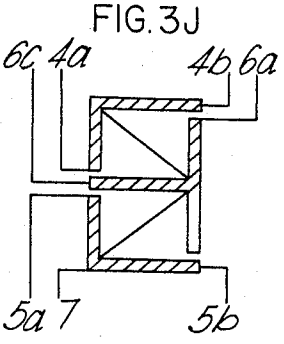



FIG. 3J



# THERMAL PRINTING HEAD

This invention relates to a printing head for use in thermal printing.

With modern high-speed computers, it has become necessary to provide printers capable of printing the information which such computers have processed and prepared for read-out. To meet the requirement, various types of thermal printers have been proposed in place of the conventional mechanical printers.

The thermal printers employ thermally-sensitive recording media and are provided with a printing head including resistive elements which are selectively heated so as to form a character, numeral or other symbol to be printed on the recording material.

In one known type of printing head, a plurality, say, seven, film resistors arranged in a predetermined pattern on one surface of a thin insulating base, and a plurality, say, five, such bases with film resistors arranged thereon in different patterns are laminated into a unitary block, so that the resistive elements on all the bases appear as equidistantly spaced dots in rows and columns on one surface of the block. When a character or symbol is to be printed by the printing head, those of the resistive elements on the block which correspond to the character or symbol are selectively energized to produce heat to be applied to a heat-sensitive paper to print the character or symbol thereon.

However, the process of manufacturing the printing head of the above type is rather complicated and time-consuming and the cost therefor is accordingly high. Since the resistive elements are applied to one surface of the insulating base, the work involved in the manufacture is complex. If the base is relatively thick, a block composed of many such thick bases would necessarily become bulky in size, with a large space between the heating elements causing the printed symbol formed by dots to appear obscure.

Accordingly, the primary object of the invention is to provide a thermal printing head which is simple in construction and easy to manufacture.

Another object of the invention is to provide a thermal printing head which is capable of printing different symbols by means of a plurality of heat-producing resistive elements selectively energized through a simplified electrical connection.

Another object of the invention is to provide a thermal printing head which includes a plurality of heat-producing resistive elements arranged into the figure "8" so that the elements are selectively energized to print different symbols on thermally-sensitive recording media.

Another object of the invention is to provide a printing head which includes a plurality of heat-producing resistive elements, and wherein the conductors supplying electrical energy to the elements are so arranged as not to interfere with feeding of the recording paper.

The printing head of the invention comprises a block made of a suitable insulating material. A thermal printing multi-symbol unit is formed on one end surface of the block and comprises a combination of a plurality of heating elements. In the illustrated embodiment to be described later in detail, the unit may comprise three heating elements arranged in the shape of the numeral 8. Two of the three elements are L-shaped while the third is T-shaped. By selectively combining portions of the elements it is possible to provide the numerals "0" through "9". Thus the multi-symbol unit can print the ten numerals 0 through 9. However, only one of the numerals can be printed at one time. Therefore, if it is desired to print several numerals or a several-digit number at one and the same time, it is necessary to provide a plurality of blocks each having a single multi-symbol unit thereon, or a single block having a plurality of multi-symbol units arranged side by side thereon.



If the heating elements are electrically resistive elements, it is necessary to supply electric energy to the elements. Leads or conductors for supplying electric energy to the elements are printed or otherwise formed on the front end surface of the block on which the resistive elements are formed and extend therefrom across the adjacent surfaces of the block to the rear end surface thereof. The leads are preferably formed by a thick film directly on the surfaces of the block so that they may not be separated therefrom. The leads formed on the surfaces of the block will never obstruct or interfere with feeding of a sheet of heat-sensitive recording paper on which printing is to be conducted by the printing head.

The resistive element may either be formed linear or more preferably comprise a combination of two or more linear portions one end of each of which meets the other linear portion to form a junction. In this latter case, each linear portion is used as an independent heating element.

If two leads are used to connect the opposite ends of each heating element to the source of electricity, there are needed twice as many leads as there are heating elements. However, if a common lead is connected to the meeting ends of the linear portions of the resistive elements with two more leads being connected to the opposite ends thereof, the number of leads required to selectively energize the linear portions of the resistive elements is more by one than the number of the linear portions of the elements. If the multi-symbol unit comprises a plurality of heating elements each of which in turn comprises a plurality of linear portions the one ends of which meet at a junction, the junctions of all the heating elements included in the unit may be connected together by a common lead with a resulting decrease in the number of leads required for connection.

The invention will be described in further detail with reference to the accompanying drawing, wherein:

FIG. 1 is a perspective view of one embodiment of the invention showing the printing head together with a sheet of recording paper;

FIG. 2 is an enlarged, fragmentary front view of one printing multi-symbol unit on the front face of the printing block shown in FIG. 1; and

FIG. 3A through 3J are front views of the multi-symbol unit comprising the three resistive elements and the leads connected thereto, the elements shown as expressing the numerals 0 through 9.

Referring to the drawing, there is shown a block 1 made of an insulating material such as a ceramic. The block 1 has a thickness which depends upon the size of the symbols to be printed within a range of from 5 mm to 10 mm. The block is provided on one surface 2 thereof with a plurality, say, four, thermal printing multi-symbol units 3 arranged side by side so as to print a plurality, say, four, symbols at the same time. In the illustrated embodiment, each unit 3 is able to selectively print 10 numerals 0 to 9 and comprises three heat-producing resistive elements 4, 5 and 6 which are ar-

ranged in the form of the numeral 8. The elements 4 and 5 are L-shaped and disposed one above the other, while the element 6 is T-shaped and interposed between the two elements 4 and 5 to complete the shape of the numeral 8, as shown in FIG. 2. The elements 4–6 preferably are made of a thick film. The elements 4 and 5 comprise two linear portions which meet at a junction 41–51 while the element 6 comprises three linear portions which meet at a junction 61. The elements may of course be of any other suitable shapes provided that they are combined to form the shape of the numeral 8.

Leads 4*a* and 4*b* are connected to the opposite ends of the element 4. Similarly, leads 5*a* and 5*b* are connected to the opposite ends of the element 5, and leads 6*a*, 6*b* and 6*c* are connected to the three ends of the element 6 opposite to the junction 61. The junctions 41 and 61 are connected by a lead 7*a* while the junctions 51 and 61 are connected by a lead 7*b* which is connected to the lead 7*a*, with a lead 7 being connected to the lead 7*b* at the junction 51. Each of these leads are preferably made of a thick film applied to the front end surface 2 of the block 1. The leads extend from the front end surface 2 to lie on the upper and/or lower surface of the block as far as the rear end surface thereof. The rear portion of the block 1 is disposed in a controller 9, which includes a control circuit to which the leads are connected to selectively energize the heat-producing resistive elements in accordance with the numeral to be printed in a well-known manner.

The lead 7 is always connected to a source of electricity since this lead 7 is commonly used to energize all the resistive elements in the unit, and the other leads are selectively connected to the same source by the control circuit.

FIG. 3 shows which of the leads are to be selected to energize which of the resistive elements of the unit to provide a numeral from 0 to 9. The elements or their portions to be heated are shown hatched in the drawing figure. The numerals 0 to 9 are shown reversed, but when printed on a sheet of paper they appear in proper position as will be easily understood.

For example, when the numeral 2 is to be printed, the six leads 4*a*, 4*b*, 5*b*, 6*b* and 6*c* are selected and connected to one terminal of the source, whereupon the element 4 is wholly heated while the elements 5 and 6 are partially heated, that is, those hatched portions alone of the latter two elements are heated as shown in FIG. 3*c*. To take the numeral 6 as another example, the six leads 4*b*, 5*a*, 5*b*, 6*a*, 6*c* are selected so that the source is connected between these six selected leads and the common lead 7, whereupon as shown hatched in FIG. 3G the elements 5 and 6 are wholly heated with the element 4 being partially heated. Similarly, when the other numerals are to be printed, those of leads except for the lead 7 which correspond to the numeral to be printed are selected. As previously mentioned the lead 7 is always connected to one of the output terminals of the source of electricity when any one of the numerals is printed.

A sheet of thermally-sensitive paper 10 is guided by a pair of spaced rollers 11 and 12 so that the portion of the paper on which the numerals are to be printed is positioned in parallel with the front surface of the head. When the printing is conducted, the paper is stopped, and when the selected portions of the heating elements have been heated in the above mentioned manner, either the paper or the printing head or both are moved so as to effect mutual contact between the heat-sensitive surface of the paper and the heated elements on the front face of the printing head 1.

The arrangement may also be such that the paper is always placed in contact with the printing head. In this case, when the paper is moved relative to the printing head, the heating elements must not be heated, and if the paper is moved after a numeral has been printed thereon, the heating elements that have been heated must be sufficiently cooled so as not to effect printing of the numeral on the new portion of the paper.

Resistive paste made of ruthenium oxide can advantageously be used as the heating elements. The elements are formed on the base by printing them twice thereon with the paste, so that they are more than 30 $\mu$ thick. A clear print has been obtained.

What I claim is:

1. A thermal printing head, coupled to a source of electrical energy having first and second terminals, for printing by actuation adjacent thermally sensitive paper, comprising:
   - a body having a first surface composed primarily of electrically insulating material;
   - a plurality of heating elements positioned on said first surface of said body two of said heating elements being positioned to define a common junction therebetween and forming a first L-shaped heating element section, two other heating elements being positioned to define a common junction therebetween and forming a second L-shaped heating element section, and three additional heating elements being positioned to define a common junction therebetween and forming a T-shaped heating element section;
   - first electrically conductive means for connecting in common a first portion of substantially all of said heating elements to the first terminal, wherein said first portion of said two heating elements is adjacent said common junction; and

2. An apparatus of claim 1, wherein said heating elements are elongated.

3. An apparatus of claim 1, wherein said first and second electrically conductive means are positioned on said first surface.

4. An apparatus of claim 1, wherein said plurality of heating elements are positioned on said surface substantially in the form of a figure 8.

5. An apparatus of claim 1, wherein said heating elements are at least 30 microns thick.

6. An apparatus of claim 1, wherein said plurality of heating elements defines a multi-symbol unit, and wherein said printing head includes a plurality of said multi-symbol units arranged on said body.

7. An apparatus of claim 3, wherein said first and second electrically conducting means are made of the same material as said heating elements.

8. An apparatus of claim 1, wherein said first and second electrically connecting means are elongated, and narrower than said heating elements.

9. A thermal printing head, coupled to a source of electrical energy having first and second terminals, for printing by actuation adjacent thermally sensitive paper, comprising:
   - a body having a first surface composed primarily of electrically insulating material;

a plurality of heating elements positioned on said first surface, each heating element composed of a thick film substantially at least 30 microns thick;

means for coupling first and second portions of selected heating elements to the first and second terminals, respectively, said first and second portions of each selected heating element defining element segments therebetween, said element segments being heated by said source of electrical energy to actuate the adjacent thermally sensitive paper.

**10.** An apparatus of claim **9,** wherein said thick film is applied to said first surface in the form of a resistive paste.



**11.** An apparatus of claim **9,** wherein said coupling means is composed of primarily the same material as is said heating elements.

**12.** An apparatus of claim **9,** wherein said coupling means is composed of a thick film substantially at least 30 microns thick.

**13.** An apparatus of claim **9,** wherein said heating elements are positioned in the form of the numeral 8.

**14.** An apparatus of claim **9,** wherein said plurality of heating elements defines a multi-symbol unit, and wherein said printing head includes a plurality of said multi-symbol units positioned on said body.

* * * * *