United States Patent [19]

Lane, III

[11] **3,862,394**

[45] **Jan. 21, 1975**

[54] **THERMAL RECORDING PRINT HEAD AND METHOD FOR MANUFACTURING SAME**

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[73] Assignee: **Honeywell Inc.,** Minneapolis, Minn.

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[21] Appl. No.: **457,622**

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

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

[58] **Field of Search** ..... 346/76 R, 139 C; 219/216

[56] **References Cited**

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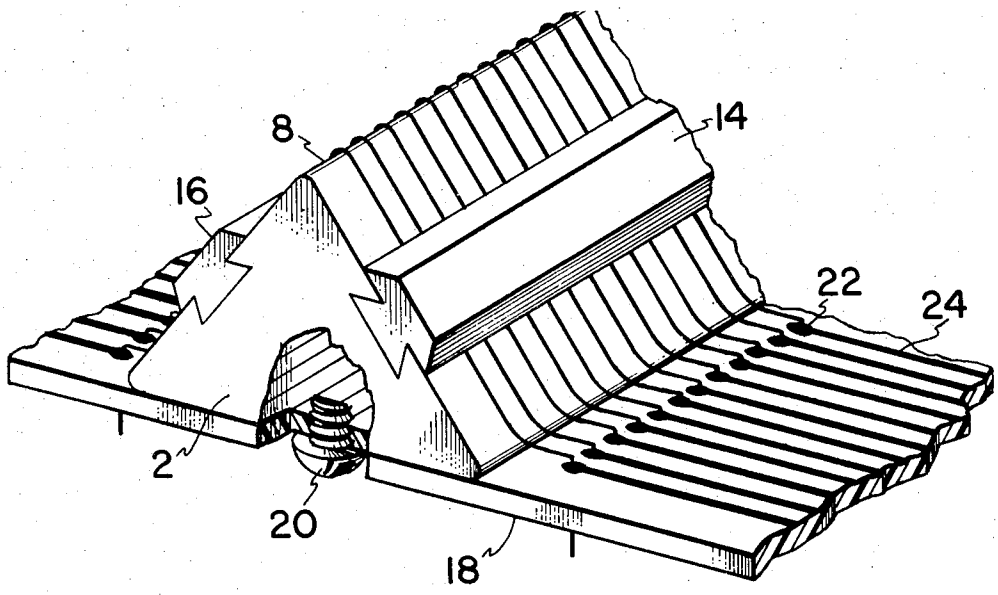
Primary Examiner—C. L. Albritton

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[57] **ABSTRACT**

A thermal print head and a method of manufacturing it using a thermally stable support mandrel and a plurality of spaced turns of copper-coated resistance wire wrapped on the mandrel. The turns are held on the mandrel by slabs of potting compound retained in under-cut grooves on the mandrel while the connections to the print elements are made by slitting the turns along a longitudinal groove in the mandrel. The copper coating is removed to expose the resistance wire at the desired printing element locations.

8 Claims, 5 Drawing Figures



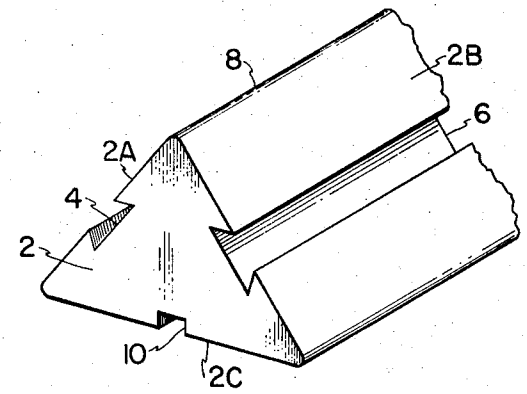


FIG. 1

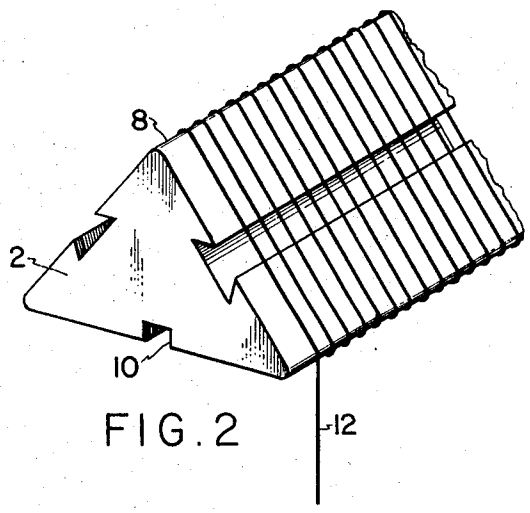


FIG. 2

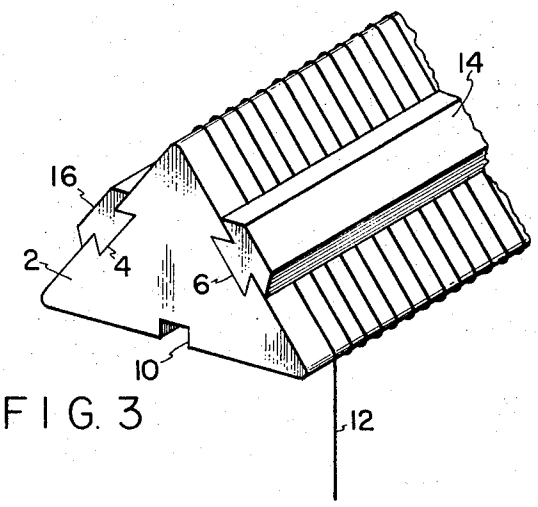


FIG. 3

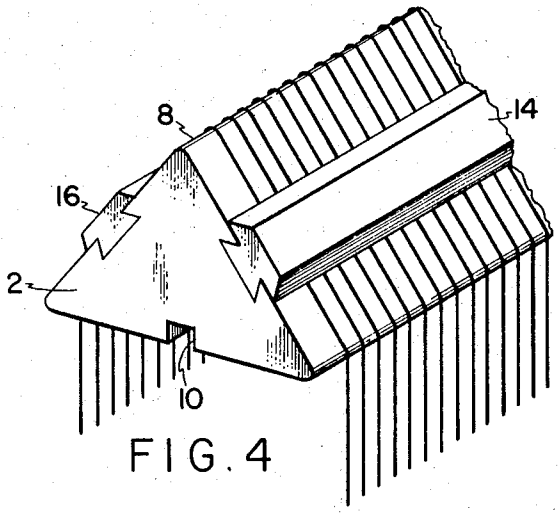


FIG. 4

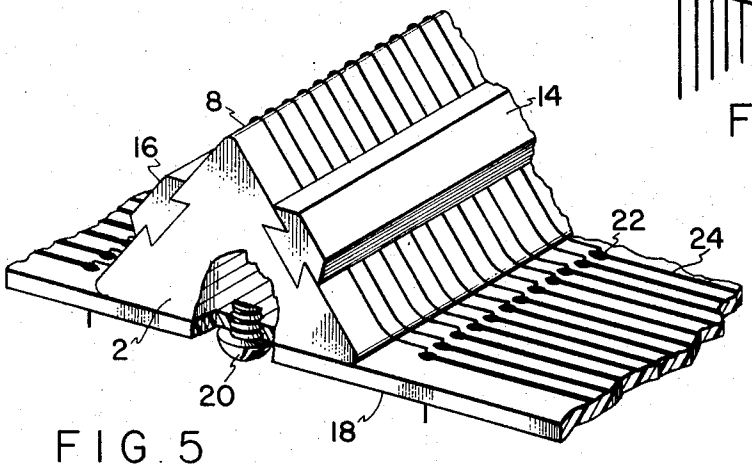


FIG. 5

THERMAL RECORDING PRINT HEAD AND METHOD FOR MANUFACTURING SAME

CROSS REFERENCE TO RELATED APPLICATIONS

Subject matter shown but not claimed herein is shown and claimed in a divisional application of Charles e. Lane, III having Ser. No. 490,230, filed on July 22, 1974

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a thermal printer print head and to a method for manufacturing such a head. More specifically, the present invention is directed to a thermal printer print head for thermal recording on a heat sensitive recording medium and for mounting on a printed circuit board. Thermal print heads may be found in Class **219** Electric Heating, Subclass **216** of the United States Patent Office classification system.

2. Description of the Prior Art

In order to obviate the problems associated with conventional recording techniques in recording information, particularly from data processing systems, thermal recorders have been developed for recording on a thermally responsive recording medium. For example, such thermal recorders obviate the use of an inking pen which type of pen is undesirable for many recorder applications because of problems associated with clogging of the pen as well as the need to replenish the ink supply. Similarly, the thermal recorder is free of the problems associated with a high voltage type of recording wherein recording electrodes using an electric arc to mark a recording medium are exposed to arc erosion while the arc imposes limitations on the environmental exposure of the recording apparatus, e.g., an explosive atmosphere. Further, the thermal recorder can be used for recording analog and digital information on the same recording medium. Conventional thermal recording devices are shown in U.S. Pat. Nos. 3,145,071; 3,312,979; 3,334,352; 3,354,817; 3,453,647; and 3,718,564. While these prior art thermal recorders are capable of recording on a thermally responsive medium, none of the aforesaid recorders employs a recording head which is capable of being assembled by an automatic manufacturing technique. Further, a practical thermal print head must lend itself for use with printed circuits to minimize the manufacturing costs thereof and to produce a miniaturized print head capable of operating as a high speed printing element, i.e., a light weight printing head having minimal thermal inertia, or heating and cooling time.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an improved thermal print head adaptable for automatic manufacturing techniques while exhibiting high speed recording capabilities in a miniaturized assembly.

Another object of the present invention is to provide a novel method of manufacturing a thermal print head.

In accomplishing these and other objects, there has been provided, in accordance with the present invention, a thermal print head having a plurality of spaced resistance heating elements supported on a first longitudinal edge of a thermally stable triangular cross-section support mandrel. A longitudinal undercut groove is located in each face of the support mandrel adjacent to this first longitudinal edge with a first free end of each of the heating elements passing across a first one of the longitudinal grooves and a second free end of each of the heating elements passing across a second one of the longitudinal grooves. A retainer means is located within each of the grooves and is arranged to encompass the portion of the heating elements passing across a corresponding groove to retain the heating elements on the first longitudinal edge and to fill the corresponding longitudinal groove. The print head is manufactured by a method including the steps of winding a resistance heating wire having an electrically conductive coating with spaced turns on the mandrel with each turn of the wire passing across the first longitudinal support edge of the mandrel to form a thermal printing element at the apex of the first longitudinal support edge, and moulding a slab of retaining material around the portions of the wires passing over the undercut grooves while filling the undercut groove by the retaining material to be retained therein. The wire turns are cut along a third longitudinal groove located in a third face of the mandrel to form free wire ends for each printing element suitable for providing a connection to energizing circuits for the print head.

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the present invention may be had when the following detailed description is read in connection with the accompanying drawings in which:

FIGS. **1** through **4** are step-by-step illustrations of a sequential manufacturing techniques embodying the present invention for producing a novel thermal recording head, and

FIG. **5** is a cross-section of an assembled and mounted novel thermal recording head formed by the method shown in FIGS. **1** to **4.**

DESCRIPTION OF THE PREFERRED EMBODIMENT DETAILED DESCRIPTION

Referring to FIGS. **1** to **4** in more detail, there is shown a sequential manufacturing operation embodying the present invention for producing a thermal recording head having a plurality of thermal recording elements in an integral arrangement. Starting with FIG. **1**, there is shown a thermally stable support mandrel **2** having a triangular cross-section. A pair of longitudinal undercut grooves, or dovetails, **4** and **6** are provided in adjacent faces **2A** and **2B**, respectively, of the support mandrel **2** which faces **2A** and **2B** join along one edge to define a longitudinal support edge **8.** A third face **2C** of the mandrel **8** is also provided with a longitudinal groove **10** suitable for attaching the thermal print head to a support member, as discussed hereinafter. The support mandrel **8** may be an aluminum bar which is hard-anodized and coated with a suitable material, e.g., tetrafluorethylene, to provide electrical insulation for the aluminum base member. The mandrel **8** is wound with a single layer of spaced turns of an electrically insulated and copper plated resistance wire **12** with the spaced turns of the winding passing across the first longitudinal support edge **8.** This wire consists of a core of resistance wire which is copper plated and coated with solder-through, i.e., heat-meltable, electrical insulation

to enable the resistance wire to be connected to a support member, as discussed hereinafter.

As shown in FIG. 3, a wire retaining member in the form of a slab of a potting compound **14, 16** is moulded in place on the outside surface of each of the faces **2A** and **2B** having the aforesaid undercut longitudinal grooves **4** and **6**, respectively, therein. This potting compound **14, 16** is arranged to have the turns of the resistance wire **12** embedded therein whereby to retain the wires on the mandrel **2** in a fixed spaced relationship while the portion of the potting compound extending into the undercut grooves **4** and **6** provides a means for locking the potting compound **14, 16** to the mandrel **2.** Subsequently, each of the turns of the resistance wire **12** is cut by passing a cutter (not shown) along the groove **10** located in the third face **2C** of the mandrel **2.** This cutting operation is effective to provide a pair of free ends for each of the segments of the resistance wire passing across the aforesaid first longitudinal support edge **8,** as shown in FIG. **4.**

The completed thermal print head is attached to a support member, such as a printed circuit board **18,** by self-tapping attaching screws **20** passing through the circuit board **18** into the longitudinal groove **10** in the third face **2C** of the mandrel **2.** The width and depth of the groove **10** is selected to provide suitable space for the self-tapping attaching screw **20.** The free ends of the resistance wire heating elements are attached to plated-through holes **22** in the printed circuit board **18** by any suitable soldering technique which removes the solder-through insulation from the wires and connects the copper-plating to the plated-through holes **22.** Each of the plated through holes **22** is, in turn, connected to printed wiring **24** located on the printed circuit board **18** for conducting an energizing signal to a corresponding one of the thermal printing elements and may, further, be connected to other associated equipment located on the printed circuit board **18** to minimize extraneous electrical connections.

The exposure of the core of the resistance wires forming each of the printing areas at the apex of the first longitudinal support edge **8** may be achieved either before or after attaching the thermal print head to the printed circuit board **18** by etching the wires to a predetermined distance on either side of the first support edge **8.** This etching process using, for example, a solution of ferric chloride, is arranged to remove the solder-through coating and the copper plating on the resistance wires while not affecting the electrical insulation of the surface of the mandrel **2.** Thus, the resistance wires will heat up only in the area where the copper plating has been removed since the copper plating will serve as a conductor along other portions of the resistance wires to bypass the internal core of resistive material. Thus, the amount of material to be heated to form a thermal print character is limited to the etched area on the first longitudinal support edge **8.**

Accordingly, it may be seen that there has been provided, in accordance with the present invention, a novel thermal print head and a novel method for producing the thermal print head in an automatic manufacturing operation to produce a plurality of thermal printing elements in a integral construction.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A thermal print head comprising:
- a thermally stable and electrically insulating support mandrel means having a first longitudinal support edge between a pair of mandrel faces;
- a plurality of spaced heating elements supported on said first support edge;
- a plurality of electrical conductors electrically connected to said heating elements respectively with each heating element having a pair of electrical conductors attached thereto with each electrical conductor of each pair of said electrical conductors extending across and in contact with a corresponding one of said mandrel faces, and
- retaining means for individually attaching each of said electrical conductors to said mandrel and for maintaining said spaced relationship of said heating elements.

2. A thermal print head as set forth in claim **1** wherein said retaining means includes an undercut longitudinal groove in each of said adjacent mandrel faces and a resilient slab filling each of said grooves while encompassing corresponding ones of said plurality of electrical conductors.

3. A thermal print head as set forth in claim **2** wherein said heatng elements each includes a segment of a resistance wire passing across said support edge.

4. A thermal print head as set forth in claim **3** wherein said plurality of electrically conductors are each an electrically conductive coating on said resistance wire.

5. A thermal print head as set forth in claim **4** wherein said mandrel has a triangular cross-section.

6. A thermal print head as set forth in claim **5** and further including a printed circuit board having printed wiring thereon connected to respective ones of said electrical conductors.

7. A thermal print head as set forth in claim **1** wherein said support mandrel means includes a support mandrel having an electrically insulating coating covering the outside surface of said support mandrel.

8. A print head comprising;
- a thermally stable and electrically insulating support mandrel means having a first longitudinal support edge between a pair of mandrel faces;
- a plurality of spaced printing elements supported on said first support edge;
- a plurality of electrical conductors electrically connected to said printing elements respectively with each printing element having a pair of electrical conductors attached thereto with each electrical conductor of each pair of said electrical conductors extending across a corresponding one of said mandrel faces, and
- retaining means for individually attaching each of said electrical conductors to said mandrel and for maintaining said spaced relationship of said heating elements.

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