June 30, 1970 E. ANDRICH 3,518,407

HEATING DEVICE

Filed March 27, 1968

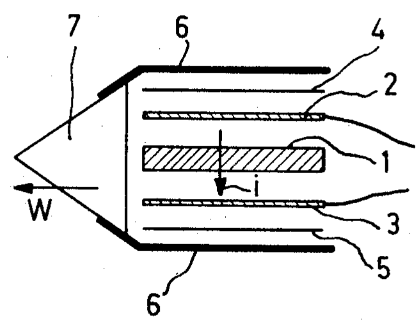

FIG.1

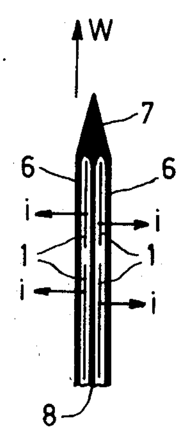

FIG.2

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HEATING DEVICE

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U.S. Cl. 219—229 4 Claims

ABSTRACT OF THE DISCLOSURE

An electrical heating device which maintains a constant temperature by the use of a heating element consisting of a material having a high positive temperature coefficient of resistance with a transition point at the desired temperature. The element is arranged coextensive with the heat flow so that heat withdrawal causes a temperature gradient in the heating element and hence a greater heating rate at that part of the element.

The invention relates to a heating device adaptable for use within an electric soldering iron. In particular, this heating device utilizes a heating element having a resistance which jumps to a high value when a certain temperature is exceeded. The use of such materials which have a positive temperature coefficient is well known and commonly referred to as PTC resistance elements or cold conductors. A material such as barium titanate, can be chosen so that when a temperature T_s is exceeded, the resistance value increases by a higher power of 10.

Known devices using PTC elements have a disadvantage in that the electric current flows through a comparatively thick resistance element and when heat is emitted, a non-homogeneous voltage drop occurs in the PTC resistance such that the voltage drop and the emission of heat takes place mainly as remotely as possible from the heat-emitting surface. Consequently, the poor thermal conductivity of the PTC resistance results in a loss of heat. The heat developed inside the element is then insufficiently supplied to the heat-emitting area due to the non-uniform heating and the non-uniform voltage jumps in the element.

This invention is characterized in that an electric supply current flows through a plate-shaped PTC resistance element in the direction of its thickness, and the resistance element is arranged with respect to a heat-emitting area so that during the emission of heat a temperature gradient occurs along the element (i.e. at right angles to the direction of the current). It should be noted that the development of heat is not the same in the various parts of the element, and this is used advantageously.

The invention will now be described more fully with reference to the accompanying drawing, in which:

FIG. 1 shows the heating part of a soldering iron.

FIG. 2 shows a modification of FIG. 1.

The device shown in FIG. 1 includes a resistance element **1** made of a material having a resistance which jumps to a high value when a temperature T_s is exceeded.

Preferably, a barium-lead titanate is used, the jumping temperature T_s of which lies at approximately 340° C. The element **1** has the form of a thin plate having a thickness of, for example, 1 mm., the largest surface of which is covered with a metal foil **2** and **3**, respectively. (In the drawing, these metal foils are spaced by a certain distance from the plate **1** for the sake of clarity, but in

actual fact, they are located very close to the plate **1**.) Insulating mica foils **4** and **5**, respectively, insulate the foils **2** and **3**, respectively, from the wall **6** of thermally good conducting material, for example, copper. The soldering tip is denoted by **7** and also consists of a thermally good conducting material, for example, copper; it may be integral with the wall **6**. The elements **1**, **2**, **3**, **4**, **5**, **6** are spaced apart in the drawing for the sake of clarity, but in actual fact they are located very close to each other.

The electric current is applied to the metal foils **2** and **3**, respectively, and flows through the plate **1** and hence in the direction of the arrow *i* at right angles to the greatest surface area of the plate **1**. Thus, the element is heated and the heat is conducted to the wall **6** and the soldering tip **7**. In the rest condition (i.e. without the supply of soldering power), an operating temperature of the plate of, for example, 350° C. to 360° C. is adjusted, which exceeds the temperature T_s. This themperature prevails, throughout the plate and the current in the plate is comparatively small.

During the soldering operation, the power is supplied mainly through the soldering tip **7**. As a result, a temperature gradient occurs along the wall **6** and the plate **1**; the coldest area is located close to the soldering tip **7** so that the current and the power produced in the plate **1** are a maximum at this area.

The heat is emitted mainly in the direction of the point of the arrow W, i.e. at right angles to the direction of the current *i*. The temperature of the resistance element **1** increases in a direction away from the soldering tip **7** (i.e. in the direction of the righthand end of the resistance element **1**). Thus, only a small current flows at this end of the resistance element **1** and the power produced does not increase much. If during operation of the soldering iron, a larger quantity of heat W is derived, the zone of low temperature is enlarged further (to the right) over the plate and the development of heat automatically matches the need of heat.

In the device shown in FIG. 2, the soldering tip **7** is joined not only to the wall **6** but also to a central plate **8**, the wall and the plate both consisting of a thermally good conducting material. Between the central plate **8** and the wall **6** are sandwiched several plate-shaped resistance elements **1** which are again provided on either side with metal current-supply foils and are insulated from the wall **6** and from the central plate **8** by insulating foils. Also in this case, the zone of low temperature is enlarged with an increased emission of heat (direction W) over a larger distance from the soldering tip **7** (i.e. at right angles to the direction *i* of the current through the resistance elements **1**).

What is claimed is:

1. A heating device for use within a soldering iron and comprising a plate-shaped positive temperature coefficient resistance element, means for creating a current flow transversely across and through the resistance element, heat insulating means for permitting heat flow in a direction perpendicular to the current flow, and heat emitting tip means thermally coactive with the resistance element for producing a longitudinal temperature gradient lengthwise along the resistance element during-heat emission.

2. A heating device as claimed in claim **1** wherein the means for creating a current flow includes sheets of metal foil placed parallel to and on either side of the resistance element.

3. A heating device as claimed in claim **4** wherein sheets of insulating mica foil are placed parallel to and on either side of the conductive metal foil.

4. A heating device as claimed in claim 3 comprising a central plate of a thermal conducting material extending from the tip means, and a plurality of resistance elements positioned on either side of the central plate.

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219—241, 505; 228—51