United States Patent [19]

Deevi et al.

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[54] **FUNCTIONALLY STEPPED, RESISTIVE CERAMIC**

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[73] Assignee: **Philip Morris Incorporated**, New York, N.Y.

[*] Notice: The term of this patent shall not extend beyond the expiration date of Pat. No. 5,498,855.

[21] Appl. No.: **614,058**

[22] Filed: **Mar. 12, 1996**

[51] **Int. Cl.^{6}** **H05B 3/58**; H01C 1/012; H01B 1/06; C04B 35/03

[52] **U.S. Cl.** **219/535**; 219/539; 338/312; 252/506; 252/516; 501/95

[58] **Field of Search** 219/535, 538, 219/539, 542, 543, 552, 553; 338/310, 312, 314; 29/614, 615; 252/506, 516, 518; 501/94, 95, 97

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[57] **ABSTRACT**

An electrically powered functionally graded ceramic composite heater and a functionally stepped ceramic composite heater useful for cigarette lighters. The electrical resistance heater includes discrete heating zones wherein each zone of the heater can be activated using an electric control module, and is capable of heating to a temperature in the range of 600° C. to 900° C. using portable energy devices. The ceramic heater can be made by pressing together layers of differing amounts of constituents of the ceramic precursor material followed by secondary processing steps to obtain discrete heating elements. The heater design can include a hub on one end to provide structural integrity, and function as a common for the heating zones.
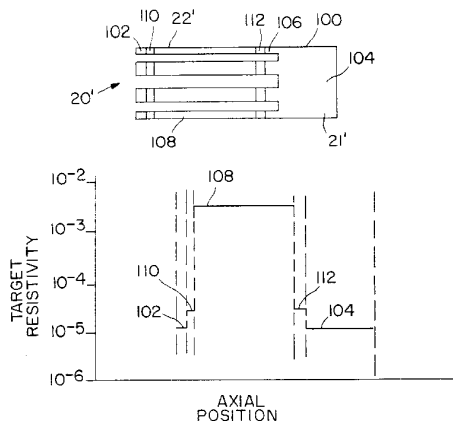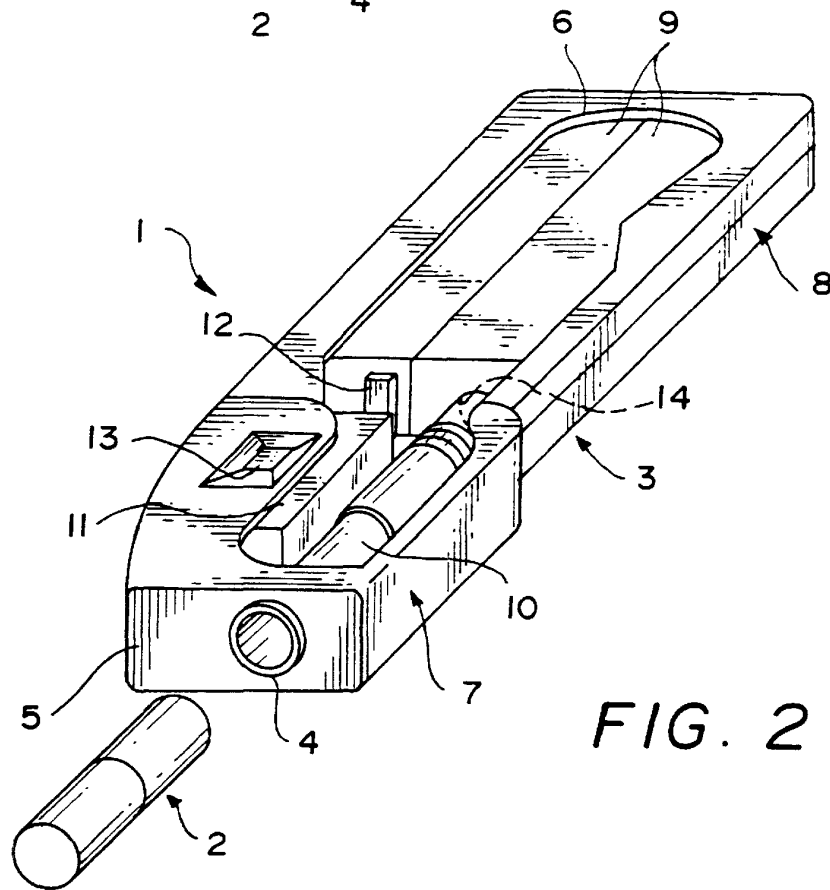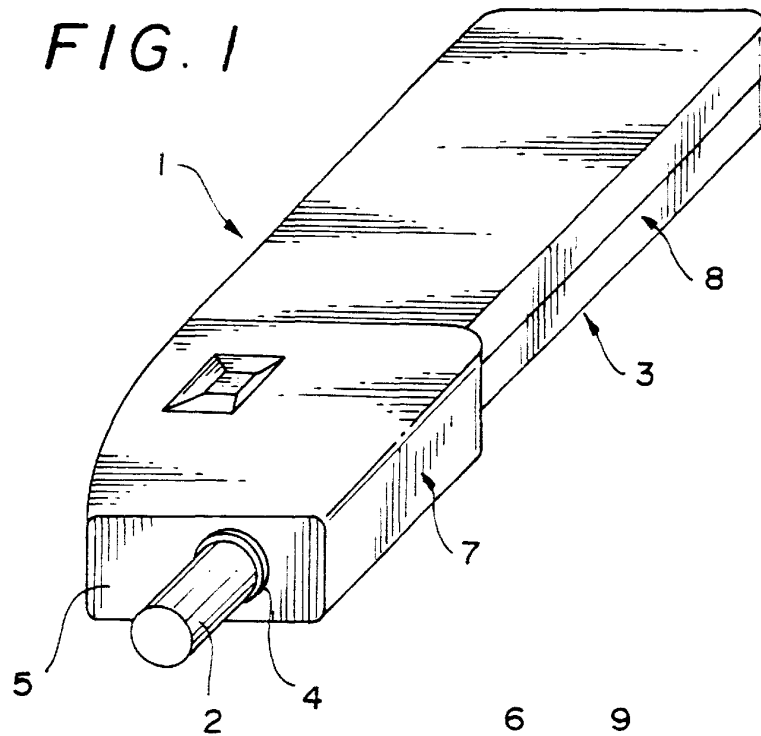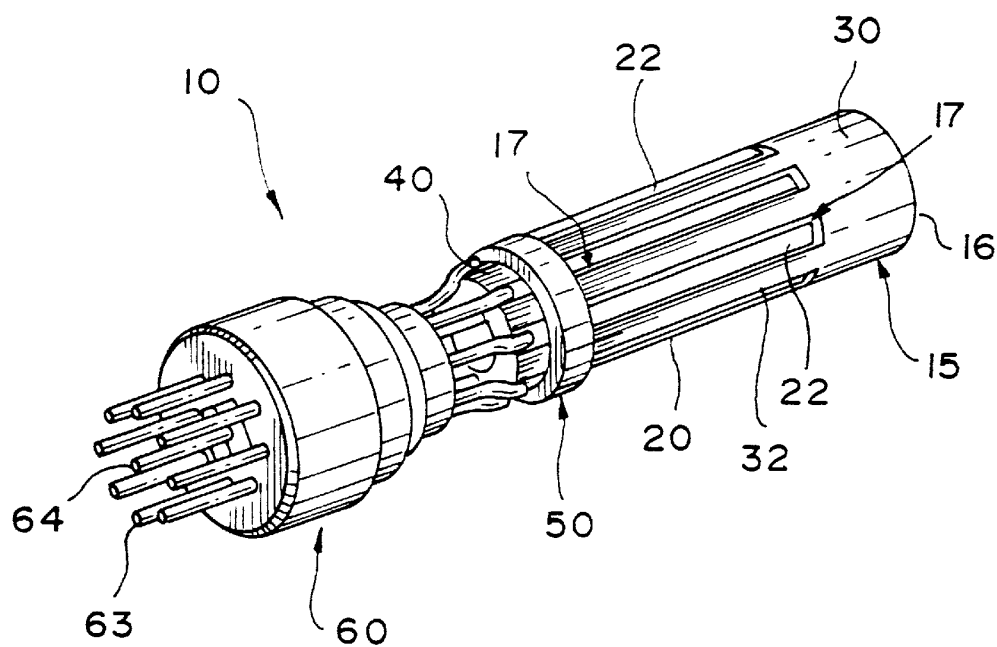
40 Claims, 14 Drawing Sheets

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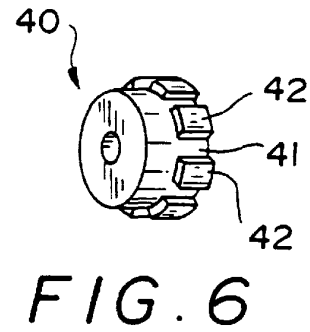FIG. 1

FIG. 2

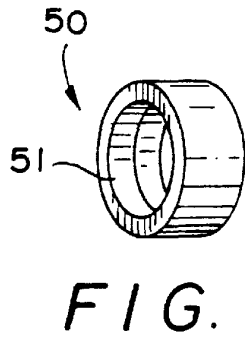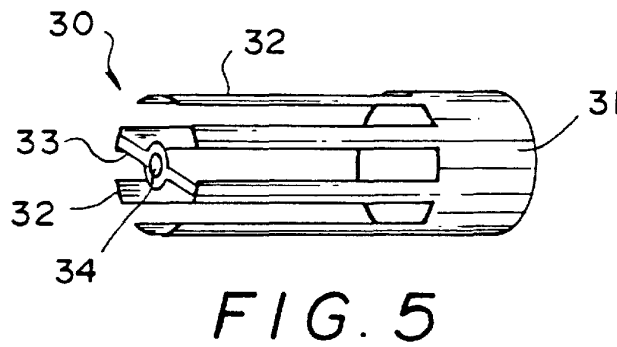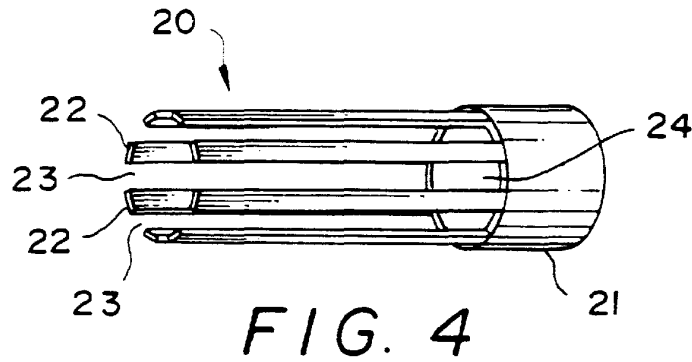FIG. 3

FIG. 4

FIG. 5

FIG. 7

FIG. 6

FIG. 8

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