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United States Patent [19]

Hajaligol

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[54] **INTERDIGITATED CYLINDRICAL HEATER FOR USE IN AN ELECTRICAL SMOKING ARTICLE**

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

[21] Appl. No.: **333,470**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 224,848, Apr. 8, 1994, which is a continuation-in-part of Ser. No. 118,665, Sep. 10, 1993, Pat. No. 5,388,594, which is a continuation-in-part of Ser. No. 943,504, Sep. 11, 1992, which is a continuation-in-part of Ser. No. 666,926, Mar. 11, 1991, abandoned, which is a continuation of Ser. No. 12,799, Feb. 2, 1993.

[51] **Int. Cl.**[6] **H05B 3/58**; A24F 1/22

[52] **U.S. Cl.** **219/535**; 219/553; 131/194

[58] **Field of Search** 219/535, 542, 219/552–553; 131/194, 197; 128/202.21, 203.27; 338/310, 312, 320; 392/386

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,971,039	2/1961	Western	219/553
4,503,319	3/1985	Moritoki	219/553
4,732,168	3/1988	Resce	131/194
4,788,077	11/1988	Kang .	
5,060,671	10/1991	Counts et al.	131/329
5,095,921	3/1992	Losee et al.	131/194
5,157,242	10/1992	Hetherington	219/553
5,224,498	7/1993	Deevi et al.	131/194
5,235,157	8/1993	Blackburn	219/268
5,249,586	10/1993	Morgan	128/203.27
5,274,214	12/1993	Blackburn	219/268
5,285,050	2/1994	Blackburn	219/268
5,322,075	6/1994	Deevi et al. .	
5,353,813	10/1994	Deevi	219/553
5,388,594	2/1995	Counts	128/203.27

OTHER PUBLICATIONS

Amin "Arc Spray Coatings Using Inert Gases," TWI Bulletin 6, pp. 129–132, Nov./Dec. 1992.

Blunt et al, "High Velocity Spraying for Electronic Substrates," TWI Connect—World Centre for Materials Joining Technology, No. 40, Dec. 1992.

Filmer et al, "Plasma Spray Deposition of Alumina–Based Ceramic," Ceramic Bulletin, vol. 69, No. 12, pp. 1955–1958, 1990.

Herman, "Coatings and Coating Practices," Advanced Materials & Processes, pp. 59–60, 84–85, Jan. 1990.

Herman, "Plasma–Sprayed Coatings," Scientific American, pp. 112–116, 1988.

Herman, "Plasma Spray Deposition Processes," MRS Bulletin, pp. 60–67, 1988.

Sampath et al, "Microstructure and Properties of Plasma–Spray Consolidated/Two–Phase Nickel Aluminides," vol. 25, pp. 1425–1430, 1991.

(List continued on next page.)

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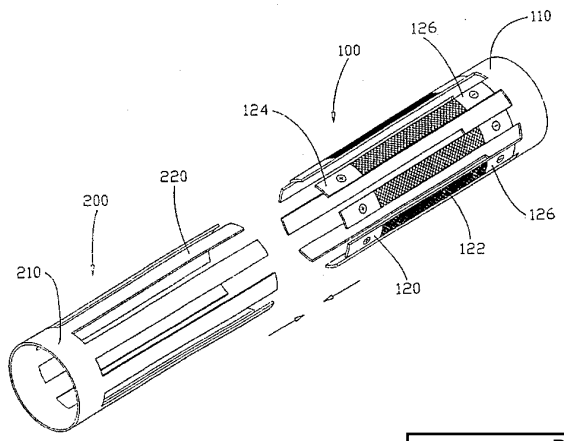
[57] **ABSTRACT**

A heater having a generally cylindrical or tubular configuration comprised of a selected plurality of thermally conductive heater blades and adjacent heat sink and aerosol barrier blades interposed between the heater blades to form an interdigitated structure. A respective gap is defined between a heater blade and an adjacent heat sink blade to prevent heat loss during an electrical pulse which heats the heater blade. During the subsequent cooling period and puff interval, the adjacent heat sink blades prevent heat from propagating to other parts of the aerosol generating tube, i.e., the cigarette. In addition to the thermal function, the barrier blades also block the escape of moisture generated by the aerosol generating medium, thereby limiting the propagation of condensation. The respective gaps between the interdigitated blades are defined to be wide enough to prevent heat losses during pulsing from a heater blade to adjacent blades yet small enough to prevent escape of significant amounts of vapor.

49 Claims, 12 Drawing Sheets



OTHER PUBLICATIONS

Sampath et al, "Structure and Properties of Vacuum Plasma Sprayed Hard Coatings," Memories et Etudes Scientifiques Revue de Metallurgie, pp. 289–294, Mai 1991.

Srivatsan et al, "Review Use of Spray Techniques to Synthesize Particulate–Reinforced Metal–Matrix Composites," Journal of Materials Science 27, pp. 5965–5981, 1992.

Street et al, "Trends In Laser Cutting of Advanced Materials," TWI Bulletin 5, pp. 108–111, Sep./Oct. 1992.

Tiwari et al, Spray Forming of $MoSi_2$ and $MoSi_2$–Based Composites, Mat. Res. Soc. Symp. Proc., vol. 213, Materials Research Society, pp. 807–813, 1991.

Tiwari et al, "Thermal Spray Forming of Particulate Composites," Dept. of Mat. Sci. & Engineering, State University of New York, Stony Brook, NY 11794–2275 and Flame Spray Industries, Inc., 152 Haven Ave., Port Washington, NY 11050.

Tiwari et al, "Incorporating of Reinforcements in Spray Formed MMCs", Department of Materials Science and Engineering, State University of New York, Stony Brook, NY 11794–2275.

Travis, "Making Materials That Are Good to the Last Drop," Research News, vol. 258, p. 1307, Nov. 1992.

Wang et al, "Activation Energy for Crystal Growth Using Isothermal and Continuous Heating Processes", Journal of Materials Science, Chapman and Hall, vol. 25, pp. 2339–2343, 1990.

Wang et al, "Thermomechanical Properties of Plasma–Sprayed Oxides in the $MgO–Al_2O_3–SiO_2$ system," Surface and Coatings Technology, vol. 42, pp. 203–216, 1990.

Wu et al, "Heat Transfer to a Particle in a Thermal Plasma," Trans IChemE, vol. 69, Part A, pp. 21–24, Jan. 1991.

Zaat, "A Quarter of a Century of Plasma Spraying," Ann Rev. Mater. Sci.by Annual Reviews, Inc., pp. 13:9–42, 1983.

Zatorski et al, "Wear of Plasma–Sprayed Alumina–Titania Coatings," High Performance Ceramic Films and Coatings by Elsevier Science Publishers B. V., pp., 591–601, 1991.

Fen et al., "Cyclic Oxidation of Haynes 230 alloy," Chapman & Hall, pp. 1514–1520 (1992).

Reinshagen and Sikka, "Thermal Spraying of Selected Aluminides," Proceedings of the Fourth National Thermal Spray Conference, Pittsburgh, PA, USA, pp. 307–313, (4–10 May 1991).

Kutner, "Thermal Spray by Design," Reprint from Advanced Materials & Processes incorporating Metal Progress, Oct. (1988).

"Characterizing THERMAL SPRAY COATINGS," article based on presentations made at the fourth National Thermal Spray Conference, 4–10 May (1991) and which appeared in "Advanced Materials and Processes," May 1992, pp. 23–27.

Howes, Jr., "Computerized Plasma Control for Applying Medical–Quality Coatings," Industrial Heating, pp. 22–25, Aug., 1993.

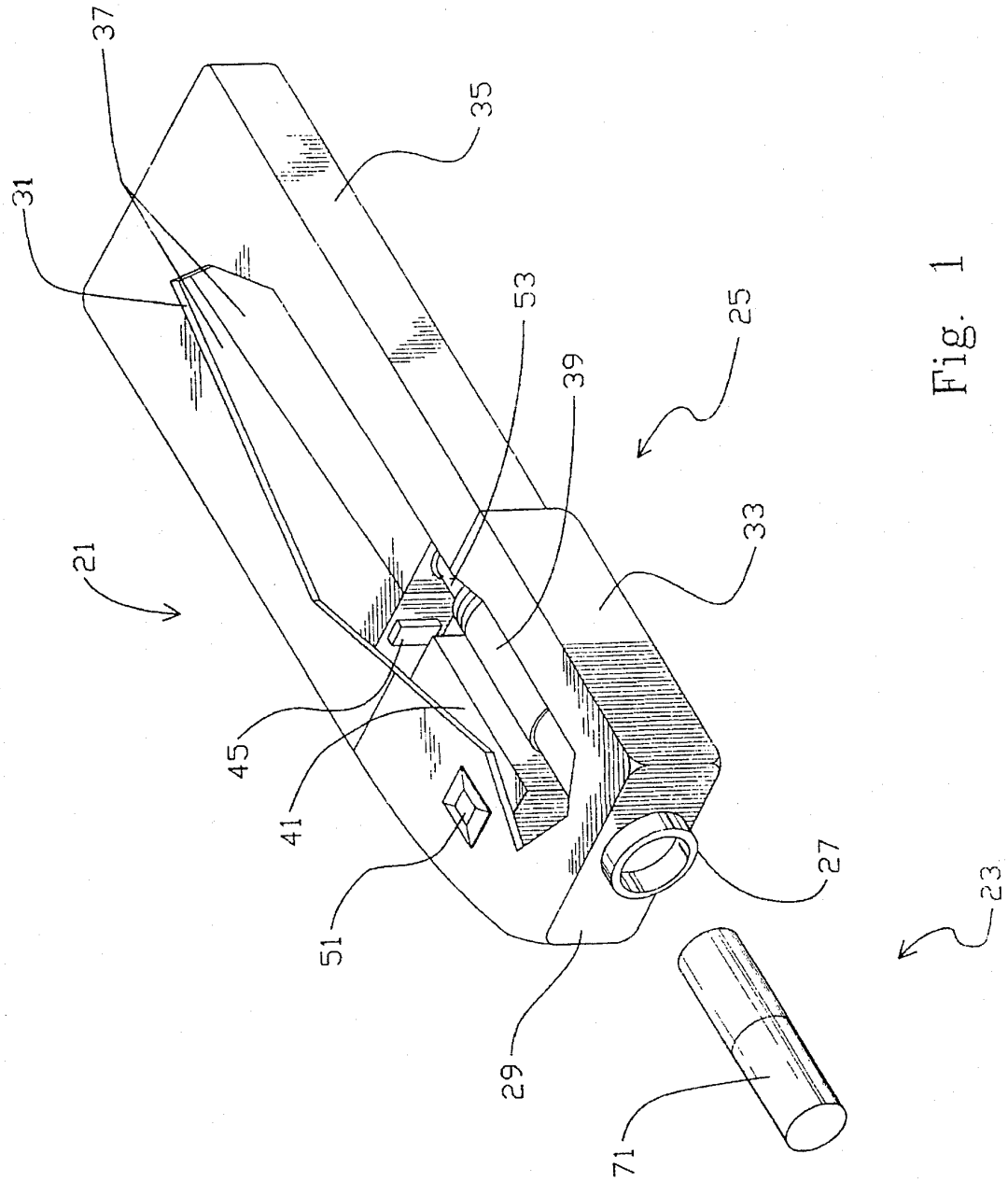


Fig. 1

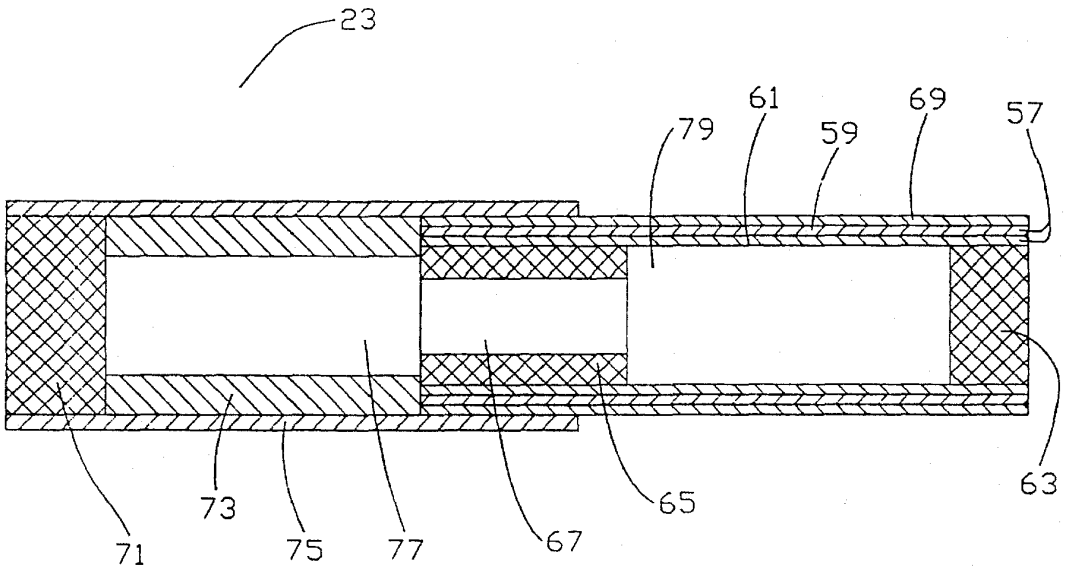


Fig. 2

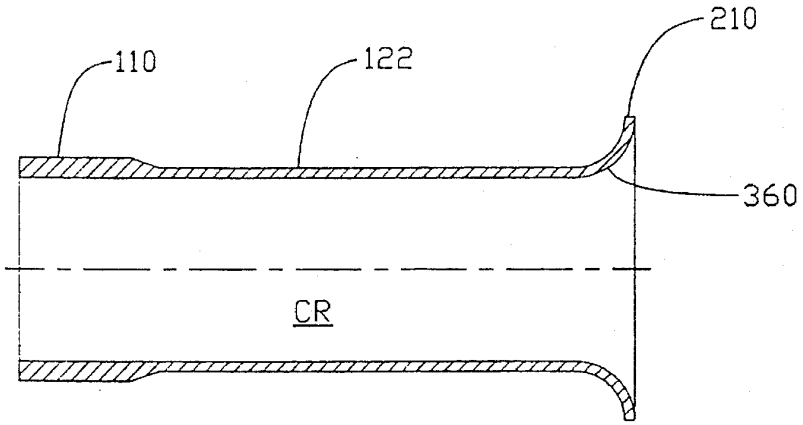


Fig. 6

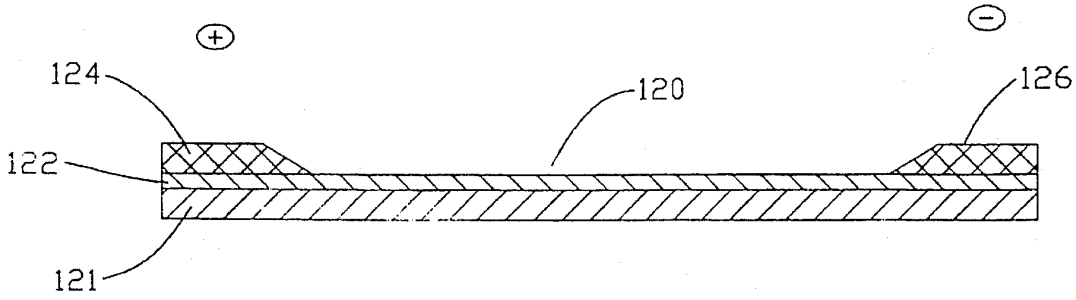


Fig. 3

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