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# United States Patent [19]

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- [54] **TEMPERATURE CONTROLLING DEVICE FOR AEROSOL DRUG DELIVERY**
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- [52] **U.S. Cl.** ..... **128/203.26; 128/204.17**
- [58] **Field of Search** ..... **128/203.26, 204.17; 261/153**

Byron, Peter R., "Prediction of Drug Residence Times in Regions of the Human Respiratory Tract Following Aerosol Inhalation", *J. of Pharm. Sciences* (1986) 75(5):433-438.

Farr, Stephen J., et al., "AERx—Development of a Novel Liquid Aerosol Delivery System Concept to Clinic", *Respiratory Drug Delivery V* (1996) pp. 175-185.

Hickey, A.J., et al., "Effect of Hydrophobic Coating on the Behavior of a Hygroscopic Aerosol Powder in an Environment of Controlled Temperature and Relative Humidity", *J. of Pharm. Sciences* (1990) 79(11):1009-1014.

Phipps, Paul R., et al., "Droplets Produced by Medical Nebulizers: Some Factors Affecting Their Size and Solute Concentration" *Chest* (1990) 97:1327-1332.

### [56] References Cited

#### U.S. PATENT DOCUMENTS

- 4,587,966 5/1986 Albarda .
- 4,653,494 3/1987 Ruderian .
- 4,922,901 5/1990 Brooks et al. .
- 5,038,769 8/1991 Krauser .
- 5,497,763 3/1996 Lloyd et al. .
- 5,660,166 8/1997 Lloyd et al. .
- 5,665,262 9/1997 Hajaligol et al. .
- 5,672,581 9/1997 Rubsamen et al. .
- 5,709,202 1/1998 Lloyd et al. .
- 5,718,222 2/1998 Lloyd et al. .

#### OTHER PUBLICATIONS

Bates, David V., et al., "Deposition and Retention Models for Internal Dosimetry of the Human Respiratory Tract", *Health Physics* (1966) 12:173-207.

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### [57] ABSTRACT

A portable air temperature controlling device useful for warming air surrounding an aerosolized drug formulation is described. Warming the air of an aerosol makes it possible to reduce the size of aerosol particles produced by an aerosol generation device. Additionally, warming the air forces the size of the aerosol particles to be in the range required for systemic drug delivery independent of ambient conditions. Smaller particles can be more precisely targeted to different areas of the respiratory tract.

**8 Claims, 4 Drawing Sheets**

