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(54) **CONVERSION OF NITROGEN DIOXIDE (NO_2) TO NITRIC OXIDE (NO)**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,674,429	A	7/1972	Collins
5,670,125	A	9/1997	Sheu et al.
7,947,227	B2	5/2011	Fine et al.
8,173,072	B2	5/2012	Fine et al.
8,211,368	B2	7/2012	Fine et al.
2003/0040542	A1	2/2003	Martin
2006/0048779	A1	3/2006	Rounbehler et al.
2006/0180147	A1	8/2006	Rounbehler et al.

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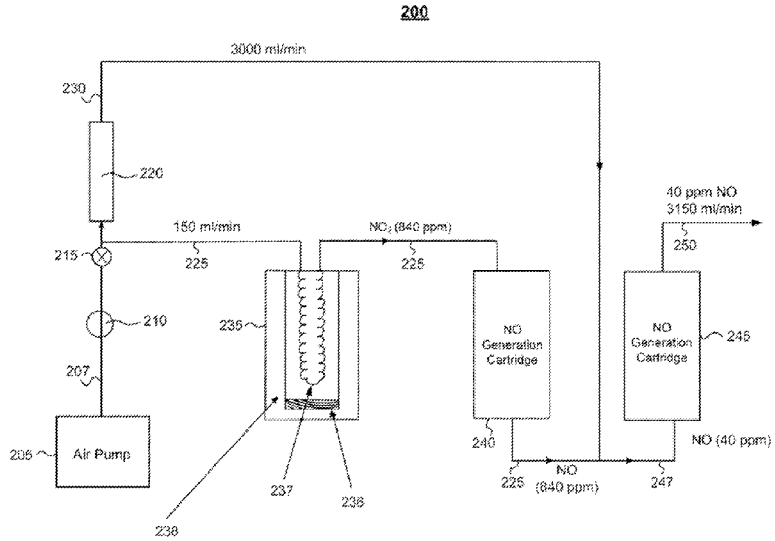
(57) **ABSTRACT**

A nitric oxide delivery system, which includes a gas bottle having nitrogen dioxide in air, converts nitrogen dioxide to nitric oxide and employs a surface-active material, such as silica gel, coated with an aqueous solution of antioxidant, such as ascorbic acid. A nitric oxide delivery system may be used to generate therapeutic gas including nitric oxide for use in delivering the therapeutic gas to a mammal.

13 Claims, 29 Drawing Sheets