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(54) **LUNG SIMULATOR FOR AN INTEGRATED HUMAN PATIENT SIMULATOR**

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(56) **References Cited**

**U.S. PATENT DOCUMENTS**

- 3,154,881 A \* 11/1964 Elwell ..... 446/24
- 4,001,950 A \* 1/1977 Blumensaadt ..... 434/265
- 4,167,070 A \* 9/1979 Orden ..... 434/272
- 5,584,701 A 12/1996 Lampotang et al.
- 5,597,310 A \* 1/1997 Edde ..... 434/272
- 5,611,335 A \* 3/1997 Makhoul et al. .... 128/204.24
- 5,622,164 A \* 4/1997 Kilis et al. .... 128/200.24
- 5,769,641 A 6/1998 Lampotang et al.
- 5,772,442 A 6/1998 Lampotang et al.
- 5,779,484 A 7/1998 Lampotang et al.
- 5,834,628 A \* 11/1998 Hunter et al. .... 73/28.04
- 5,868,579 A 2/1999 Lampotang et al.

- 5,882,207 A 3/1999 Lampotang et al.
- 5,890,908 A 4/1999 Lampotang et al.
- 5,941,710 A 8/1999 Lampotang et al.
- 6,273,728 B1 8/2001 van Meurs et al.
- 6,296,490 B1 \* 10/2001 Bowden ..... 434/265
- 6,679,259 B2 \* 1/2004 Heesch ..... 128/204.26
- 2002/0143397 A1 \* 10/2002 von Segesser ..... 623/9

**OTHER PUBLICATIONS**

Guyton, A.C. Textbook of Medical Physiology (8<sup>th</sup> ed.), W.B. Saunders Co., Philadelphia, 1991.

\* cited by examiner

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(57) **ABSTRACT**

A simulated lung for use in real time simulated medical procedures comprising a positive pressure source of a gas, a vacuum pressure source, a fixed interior volume vessel having an inlet, an outlet, and a breath passage port, the inlet in communication with the positive pressure source, and the outlet in communication with the vacuum pressure source, a first flow valve intermediate the positive pressure source and the inlet, a second flow valve intermediate the vacuum pressure source and the outlet, a pressure sensor in communication with the interior volume of the vessel, and means for continuously evaluating a pressure signal generated by the pressure sensor to a desired pressure level within the vessel during the breathing cycle such that a flow of gas entering and exiting the breath passage port of the vessel is synchronized with a predetermined desired flow rate of breathing during the breathing cycle. The desired pressure level depends upon any one of i) a time and event based script, ii) a computer model, iii) or a combination of a time and event based script and a computer model based on a physiological state of a simulated patient.

**22 Claims, 6 Drawing Sheets**

