



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>5</sup> : A61M 15/00, A62B 7/00, 7/04 A62B 9/02</p>	A1	<p>(11) International Publication Number: <b>WO 90/11791</b></p> <p>(43) International Publication Date: 18 October 1990 (18.10.90)</p>
<p>(21) International Application Number: PCT/US90/02012</p> <p>(22) International Filing Date: 13 April 1990 (13.04.90)</p> <p>(30) Priority data: 337,375                      13 April 1989 (13.04.89)                      US</p> <p>(71) Applicant: SALTER LABORATORIES [US/US]; 200 W. Sycamore Road, Arvin, CA 93203 (US).</p> <p>(72) Inventor: SALTER, Peter ; Star Route 3, Box 4250-21, Tehachapi, CA 93561 (US).</p> <p>(74) Agent: BERKSTRESSER, Jerry, W.; Shoemaker and Mattare, Ltd., Crystal Plaza Building 1, Suite 1203, 2001 Jefferson Davis Highway, Arlington, VA 22202 (US).</p>		<p>(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).</p> <p><b>Published</b> <i>With international search report.</i></p>
<p>(54) Title: DEMAND OXYGEN SYSTEM</p>		
<p>(57) Abstract</p> <p>An intermittent oxygen delivery system for supplying oxygen to a first nare (7) of a nasal cannula in response to patient's exhalation sensed through the second nare (6) which is isolated from the delivery of the oxygen to the first nare.</p>		

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DEMAND OXYGEN SYSTEM

This invention relates to oxygen delivery systems and methods during supplemental oxygen therapy and, more particularly, to a system for controlling the flow of oxygen to a patient during supplemental oxygen therapy so as to provide oxygen only during the period of patient inhalation.

Prior devices and systems developed for the purpose of conserving oxygen during the delivery of oxygen have generally involved relatively complicated pneumatic and/or electromechanical devices. Simplification of the apparatus for providing intermittent delivery of oxygen in response to a patient's inhalation and exhalation cycles is desirable and has been sought.

It is, therefore, an object of the present invention to provide a simplified system for providing an intermittent flow of oxygen to a patient during supplemental oxygen therapy.

SUMMARY OF THE INVENTION

The present invention provides a system and a method for controlling the flow of oxygen from a source of oxygen to a patient through a nasal cannula where the flow is controlled by valve means that are operated in response to the initiation of exhalation by the patient. The nasal cannula that is an essential feature of the present invention consists of a conventionally shaped nasal cannula face piece having inlet and outlet conduits communicating respectively with two separate zones in the face piece which are separated by a gas-tight partition means in the face piece. The nasal cannula is provided with two nares or tubes that terminate adjacent the patient's nostrils as is conventional, however, each nare communicates with different zones in the face piece.

The inlet conduit or tube communicates with the valve means and the source of oxygen.

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The outlet conduit communicates with sensing means capable of sensing the exhalation of the patient at a location remote from the patient and, when exhalation is sensed, the signal produced controls the closing of the valve means to interrupt the flow of oxygen. When the sensing means does not sense patient exhalation, or senses patient inhalation, the valve means remains open or is opened to provide a flow of oxygen to the patient through the inlet conduit and one nare of the face piece.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a plan view of the nasal cannula used in the present invention.

FIGURE 2 is a schematic of the system for practicing the method of the present invention.

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#### DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, a dual cannula is illustrated having a face piece 2 having a dividing web or partition 3 which divides the cannula face piece 2 into two separate zones 4 and 5 into which nares 6 and 7, respectively, communicate. In the embodiment shown, zone 4 also communicates with sensing tubing 11. Zone 5 communicates with delivery tubing 12. Tubing 11 and 12 can be the same or different outside or inside diameters. both tubes 11 and 12 terminate in a connector 15. Preferably a bolo 1 is slidably received around the tubes 11 and 12 between the connector 15 and the face piece 2 so that adjustment can be provided for the cannula to fit snugly on the patient, minimizing the chance of movement of the nares 6 and 7 from their proper position adjacent the patient's nostrils. The tubes 17 and 18 are provided with a matching connector 16 to fit connector 15. Sense tubing 11 thereby communicates with tubing 17 which terminates in a connector 20 to be attached to pressure sensing unit T, schematically shown in Figure 2.

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Likewise delivery tubing 12 communicates with tubing 18 which is connected by means of a connector 21 to the valve means V shown in Figure 2, which is connected to a source of oxygen ( $O_2$  in Figure 2). Preferably the pressure sensing unit utilizes a transducer and associated circuitry to detect changes in pressure that will occur at the initiation of exhalation and inhalation by the patient, and to produce an electrical signal capable of actuating the valve means V to open and allow oxygen delivery when the patient is not exhaling. Any sensing unit can be employed that will perform this function.

In operation, the described system of the present invention provides a method for intermittently controlling the flow of oxygen to the patient through a nasal cannula where delivery of the oxygen is restricted to one nare. The method includes providing a source of oxygen which is connected via valve means V to the one delivery nare. The breathing of the patient is sensed at the end of a sensing conduit which communicates with the nare which is not delivering oxygen, the sensing means including signal producing means for providing a control signal to operate the valve means so that changes in the pressure of the gas in the sensing conduit, produced for example by the exhalation of the patient into the sensing nare, will produce or stop the delivery of oxygen from the source of oxygen to the delivery conduit and the delivery nare.

Likewise inhalation by the patient will produce a signal to open the valve means thereby supplying oxygen to the delivery nare. The foregoing method for controlling the flow of oxygen through a nasal cannula depends on the system being provided with the components and functions described and the provision of the nasal cannula described, having a gas-tight partition separating the face piece into two zones where a delivery

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nare communicates with one zone and a sensing nare with other zone. With the face piece properly located, the system and method of the present invention are capable of delivering sufficient oxygen to accommodate the range of flow rates normally prescribed for supplemental oxygen therapy.

5 It will be appreciated that choices of tubing sizes can vary from those shown or suggested and the design of the face piece and nares can deviate from those shown while still providing the gas-tight separation of the face piece into two separate zones. Likewise, the tubing shown from the connector 15, 16 to the connectors 20 and 21 can be separate tubes or multi-channel tubing.

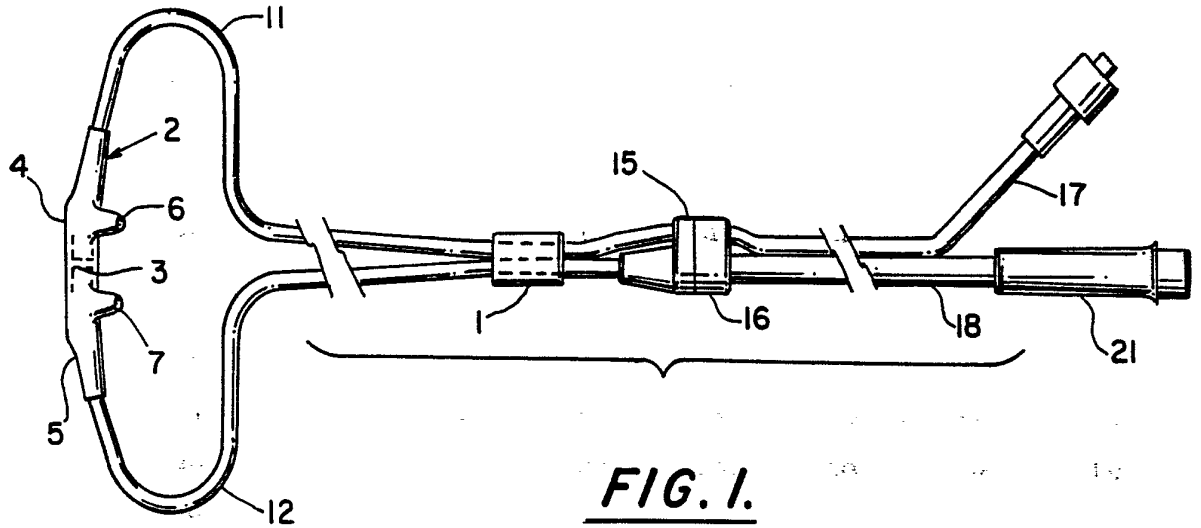
10 The present invention has been described with respect to its preferred embodiment, the scope of the invention is to be limited only to the scope of the appended claims interpreted in view of the pertinent prior art.

- 5 -

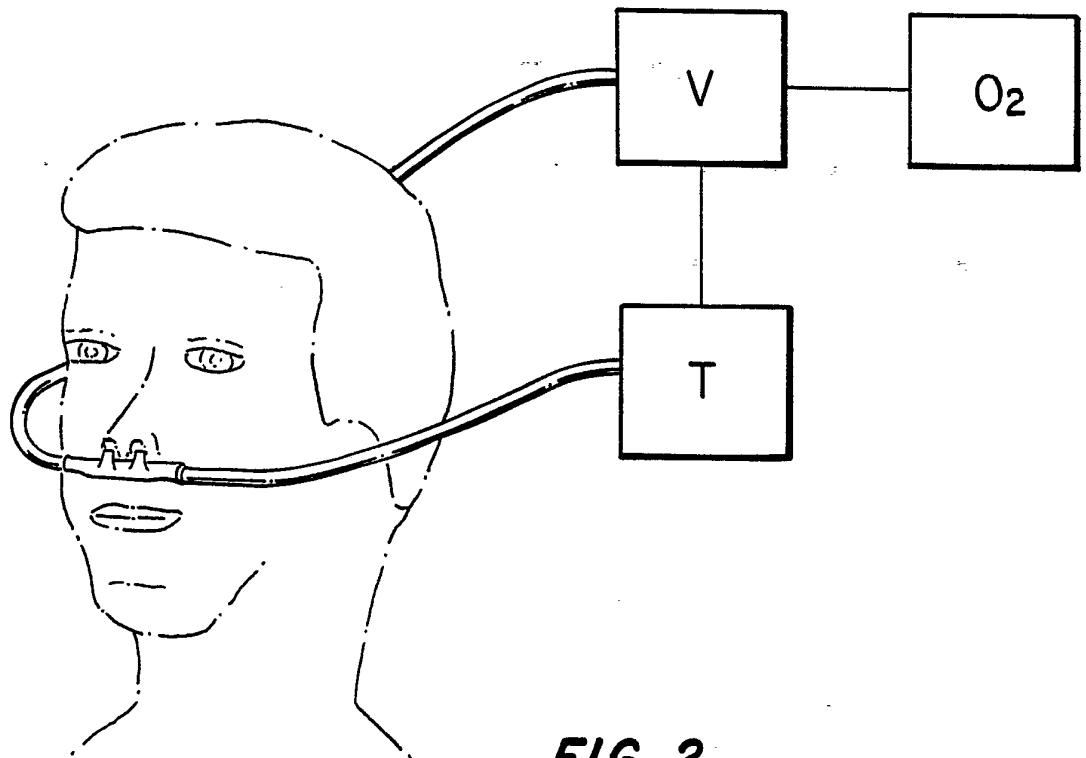
CLAIMS

1. A method of controlling the flow of oxygen to a patient through a nasal cannula having a face piece, two nares and a first and second tube conduit, comprising the steps of:
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- providing a source of oxygen;
- controlling, by valve means, the flow of oxygen to a first tube conduit of a nasal cannula;
- sensing the nasal exhalation of a patient by
- 10 sensor means, said exhalation being sensed at the end of said second tube conduit remote from the face piece of said nasal cannula;
- supplying oxygen to said cannula through said first tube conduit by the opening of said valve means in
- 15 response to signals generated by said sensor means, said valve means communicating electrically with said sensor means and cooperating therewith to provide for an intermittent supply of oxygen in response to the exhalation of the patient so that oxygen is supplied when
- 20 the patient is not exhaling;
- said cannula face piece with two nares having communication between one nare and one of said tube conduits and the other nare and the other of said tube conduits and said face piece containing a gas tight
- 25 partition separating the face piece into two separate zones where each zone communicates with one nare so that the step of sensing and the step of supplying do not communicate and thereby interfere with said control and supply.

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**FIG. 1.**



**FIG. 2.**



# INTERNATIONAL SEARCH REPORT

International Application No. **PCT/US90/02012**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>				
According to International Patent Classification (IPC) or to both National Classification and IPC <b>IPC (5) A61M 15/00; A62B 7/00, 7/04, 9/02</b> <b>U.S. Cl. 128/204.18, 204.21, 204.23, 204.26, 205.24</b>				
<b>II. FIELDS SEARCHED</b>				
Minimum Documentation Searched <sup>7</sup>				
Classification System	Classification Symbols			
<b>U.S. Cl.</b>	<b>128/204.18, 204.21, 204.23, 204.26, 205.24</b>			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>				
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>9</sup>				
Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>		
Y	US, A 4,462,398 (DURKAN ET AL.) 31 JULY 1984 See Fig. 1C	1		
Y	US, A 4,575,042 (GRIMLAND ET AL.) 11 MARCH 1986 See Figs. 1 and 2	1		
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; border: none;"> <p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width: 50%; vertical-align: top; border: none;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </td> </tr> </table>			<p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>
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<b>IV. CERTIFICATION</b>				
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report			
<b>23 May 1990</b>	<b>25 JUL 1990</b>			
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