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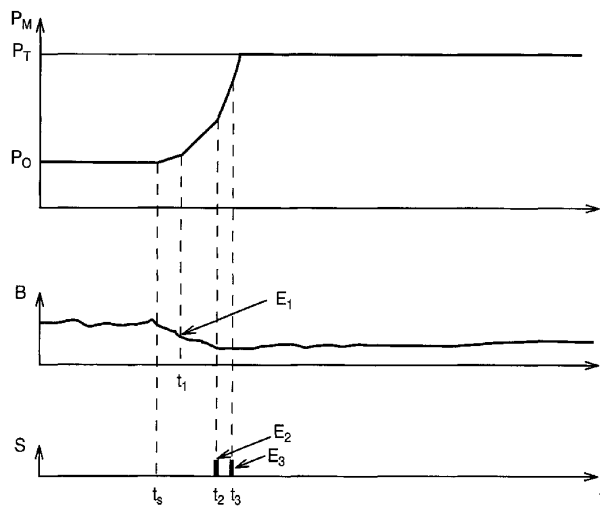
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(54) Title: APPARATUS TO ASSIST A PATIENT'S BREATHING WITH A VARIABLE RAMP PERIOD TO RISE TO TREATMENT PRESSURE



(57) Abstract: The invention concerns an apparatus (1) to assist a patient respiration by delivering air to a patient through a mask (20), comprising wherein a ramp module (10) connected to a control unit (2) in order to provide the control unit with the value of pressure  $P_M$  to settle at said mask (20), so that when said apparatus (1) starts functioning, the pressure progressively rises until the pressure of treatment  $P_T$ ; the apparatus (1) further comprising a comparator connected to the ramp module (10), at least one means for detecting the patient's breathing parameters and sending them to said comparator, so that the comparator is able to determine that an event ( $E_1$ ,  $E_2$  or  $E_3$ ) occurs in patient's breathing and to send the corresponding data to the ramp module (10) which provides the control unit (2) with a value of pressure  $P_M$  that will speed up with respect of time, so that the rise of pressure at patient's mask (20) is accelerated.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Apparatus to assist a patient's breathing with a variable  
ramp period to rise to treatment pressure**

5 Technical field

This invention concerns the field of apparatus to assist a patient respiration and more specifically an apparatus bringing progressively to the pressure of treatment the air the patient is provided with.

10

Background art

In many treatments apparatus are used to provide patients with air. More frequently they are used for patients with a breathing deficiency caused for example by  
15 the weakness of the breathing system or by obstructive apneas during the sleep. In those cases it is important to control the pressure of the air delivered to the patient. With respiratory insufficient patients, apparatus providing air at a higher pressure help to compensate the weakness of  
20 the patients lungs. In the case of patients suffering of sleep apneas, providing the air at a higher pressure removes the obstruction of the upper airways.

The pressure of treatment is usually not strong enough to wake the patient up, but can prevent him from falling  
25 asleep. An implementation of treatments apparatus is to wait for the patient to fall asleep before providing air under the treatment pressure. The classical solution is to have a ramp period, which is a slow increase of the delivered pressure from a low level to the treatment  
30 pressure.

Still to enhance the comfort of the patient, it is disclosed in patent US5,492,113 and US5,970,975 an apparatus wherein several cycles of ramp are provided on patient's conscious demand. The cycles actuated after the  
35 first cycle rise faster in pressure. All those ramps are

predetermined in shape and duration. The patient can also select a fastest shape of ramp or select one special shape in order to fall asleep more easily. This selection being made among different predetermined shapes of ramp. However, 5 such devices require from the patient a minimum of consciousness to activate the ramp cycles. This is not really very efficient to fall asleep and it is not possible when the patient as fallen asleep.

Moreover each ramp can not be modified during the time 10 when the ramp is activated.

#### Summary of the invention

The first object of the invention is to provide a ramp that would be able to modulate automatically, especially when 15 the patient falls asleep.

A second object of the invention is to provide in any case a maximum of time in rise of pressure, in order to apply the treatment in any case.

The invention thus concerns an apparatus to assist a 20 patient respiration by delivering air to a patient trough a mask, comprising:

- a blower to provide the patient with air under a treatment pressure,
- a control unit to adjust the pressure delivered by the 25 blower at the level of the patient's mask,
- a ramp module connected to the control unit in order to provide the control unit with the value of pressure  $P_M$  to settle at the mask, so that when the apparatus starts functioning, the pressure progressively rises until the 30 pressure of treatment  $P_T$ ;

the apparatus comprising a comparator connected to the ramp module, means for detecting the patient's breathing parameters and sending them to said comparator, in order that in response to breathing parameters, the comparator is able to determine 35 that an event occurs in patient's breathing and to send the corresponding data to the ramp module which provides the

control unit with a value of pressure  $P_M$  that will speed up with respect of the time, so that the rise of pressure at patient's mask is accelerated.

In an implementation of the invention, the value of pressure  $P_M$  has always maximum and/or minimum limits so that the increase of pressure is also limited in minimum and/or maximum.

Such an apparatus has the advantage to generate a ramp period which can be modulated in the same ramp, according to patient's breathing parameters.

#### Brief description of figures

The purposes, objects and characteristics of the invention will become more apparent from the following description when taken in conjunction with the accompanying drawings in which:

Figure 1 represents the apparatus schema,

Figure 2 represents the pressure delivered to the patient's mask according to special events occurring in patient's breathing,

Figure 3 represents the domain of pressure increase, and

Figure 4 represents the block diagram for the ramp period.

#### Detailed description of the invention

The apparatus according to the present invention is able to generate a ramp period which can be modulated in respect of the time required by the patient for falling asleep.

The apparatus as represented in figure 1 comprises a blower 4 to provide the patient with air. This blower is connected to a tube 8 on a first extremity, the second extremity being connected to the mask 20 wherein the patient breathes. A control unit 2 provides the blower 10 with the electrical control required to enable the blower to function in order to set a given pressure at the patient's mask or blower's outlet. This pressure could be by a pressure

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