(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 856 334 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.08.1998 Bulletin 1998/32

(51) Int Cl.[6]: **A63B 23/18**

(21) Application number: **97310327.8**

(22) Date of filing: **19.12.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **20.12.1996 GB 9626446**

(71) Applicant: **Hollanden Limited**
Beckenham, Kent BR3 2NR (GB)

(72) Inventors:
- **Phillips, Peter Edward**
  Leigh, Kent, TN11 8HU (GB)
- **Brookes, David Michael**
  Shrewsbury, Shropshire, SY3 8RY (GB)

(74) Representative: **Johnstone, Douglas Ian et al**
Baron & Warren,
18 South End
Kensington, London W8 5BU (GB)

(54) Therapeutic device

(57) A visual stimulation device for assisting in the lowering of a user's breathing rate by means of displaying a cyclical graphic representation on a display (6) comprising a grid of light emitting diodes (14). The representation comprises a bar graph adjacent bars of which are illuminated sequentially during a first display corresponding to user inhalation and extinguished during a seccnd display corresponding to user exhalation. A third display corresponding to a rest period between inhalation and exhalation may also be provided. The display is controlled by circuitry (18) including a first circuit (27) which computes the user's rest breathing rate from data input by the user in a relaxed state and a further circuit containing display duration ratio information. The duration ratio of the first to the second to the third displays is substantially 40%; 50%; 10% and the display cycle corresponds to the user's rest breathing rate in breaths per minute minus one.

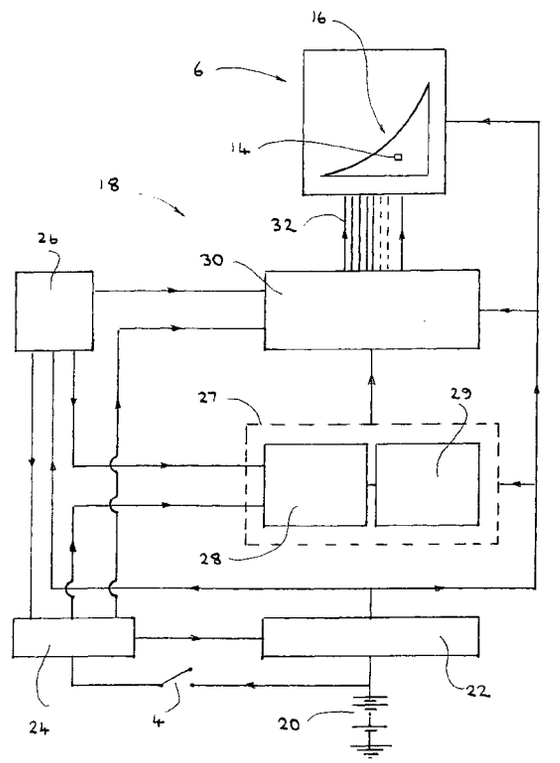

FIG. 8

EP 0 856 334 A2

Description

The present invention relates to a device for assisting in the lowering of a person's breathing rate.

It has been established that there is a link between the rate at which a person breathes and the level of stress felt by that person. Intense stress tends to increase a person's breathing rate and may induce hyperventilation in which more breathing than is necessary occurs. A consequence of hyperventilation is that breathing is effected less efficiently and carbon dioxide, in addition to oxygen, is removed from inhaled air. This produces uncomfortable symptoms such as light-headedness or dizziness, increased heart rate, numbness, tingling and twitching. These symptoms can in turn increase the feeling of stress or anxiety experienced by the person and accordingly a self perpetuating situation can arise which is difficult for the person to break out of. In such a situation, if the person is able to control their breathing rate then the symptoms can be reduced and the feeling of stress alleviated.

An object of the invention is to provide a device for assisting a person, who is breathing at an undesirably high rate, to lower their breathing rate and thereby bring it under control.

Thus according to the invention there is provided a therapeutic device for assisting in the lowering of a device user's breathing rate the device comprising display means and control means adapted to operatively control the display means so that it displays a repeating display cycle, each display cycle including a first display followed by a second display corresponding respectively to periods of user inhalation and exhalation.

A person who is breathing at an undesirably high rate can actuate the device and attempt to regulate their breathing pattern to follow the repeating display cycle. Provided the time for each display cycle has been appropriately set, the person's breathing rate will come down to or approach the desired rate more quickly than if the user had erely concentrated on the act of controlling their breathing rate without the visual stimulus provided by the device. Furthermore, the provision of something on which visual concentration can be directed enhances the stress relieving effect of the device by diverting the user's attention from whatever may be causing the stress.

Ideally, the display cycle will be set to one breath per minute less that the user's breathing rate in a totally relaxed state. This has the effect of bringing the user's breathing rate down more effectively than if the user's relaxed breathing rate itself is used.

As, in a relaxed state, a person will pause after each exhalation before taking the next inhalation, preferably the control means includes means to control the display means so that it displays a third display which occurs after termination of the second display and before commencement of the subsequent first display and corresponds to a user rest period between exhalation and inhalation.

Since a typical relaxed breathing pattern includes a longer exhalation time than inhalation time, preferably the control means includes ratio information storage means containing ratio information which is used to determine the ratio of the duration of each first display to that of the second display.

As there is an optimum ratio of inhalation duration, to exhalation duration, to rest period duration, preferably in each cycle: the first display lasts for between 30% and 50%; the second display lasts for between 40% and 60%; and the third display lasts for between 5% and 15% of the cycle time. More preferably: the first display lasts for substantially 40%; the second display lasts for substantially 50%; and the third display lasts for substantially 10% of the cycle time.

Preferably the device further includes adjusting means for adjusting the period of display cycles generated by the control means. More preferably the device can display from around 1 to around 19 display cycles per minute. This feature enables the device to be used by persons having a wide range of rest breathing rates and can accommodate changes in a user's breathing pattern. The rest breathing rate of adult humans generally varies from around 7 to around 16 cycles per minute.

In order that the device can be used as a diagnostic tool and enable a user to check what display cycle frequency the device is set for at a given time, the control means is preferably arranged to provide information in character form, on the display means, concerning the display cycle. Desirably this information comprises the number of display cycles per minute stored in the control means.

Preferably the first display comprises a representation which grows or intensifies and the second display involves a steady shrinking or dimming of the representation. More preferably these processes occur in a gradual or stepped manner. The inventor has found in particular that growing and shrinking of the representation provides a visual image which enables a device user to more easily coordinate his or her breathing pattern with that prompted by the device.

Conveniently the representation includes a graph-like image, for example adjacent strips at least some of which differ in length.

In order to make the device easily portable, so that a user can easily carry it at all times, it is preferably adapted to be held in a user's hand.

The invention also encompasses a method of operating the device.

The invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a front view of a device according to the invention;

Figures 2 to 6 show the display means forming part of the device shown in figure 1 at various points in

the display cycle;

Figure 7 shows the display means exhibiting display cycle information; and

Figure 8 shows a schematic block diagram of components constituting the device.

A device 1 according to the invention is shown in Figure 1 and includes a body 2 in which an actuation button 4 and a display means 6 are mounted. The display means 6 comprises a series of columns 8, 10, 12 of light emitting diodes (LED's) 14. The column 12 at the right hand side of the display comprises eight LED's 14 and is the highest column and column 8 at the left hand side of the display comprise a single LED 14 and is one of the shortest columns. The intervening columns 10 are graded in height between the highest and lowest columns 12, 8. Inside the casing, control means are provided which are described in outline below and which act to control illumination of the LED's 14 to produce an image 16. By selectively illuminating the LEDs, the image 16 can be made to grow and diminish or disappear completely.

The main components of the control means 18 are shown schematically in Figure 8. These components comprise: a battery 20; a command button 4 (also shown in Figure 1); a power-up circuit 22; a command signal analyser (analyser) 24; a clock 26; a breaths per minute circuit 27; and a display signal generation circuit (display circuit) 30 which is connected to the LEDs 14 in the display means 6 by LED wires 32. The main electrical connections between these components are shown in Figure 8 with arrows indicating the direction of information or data flow along the connections.

Assuming that the device has already been programed with the relevant information for a particular user then a display cycle frequency store 29 in the breaths per minute circuit 27 will contain data representing the number of breaths that the user should make per minute minus 1 (the display frequency) in a rested and relaxed state. The display circuit 30 will contain ratio information concerning duration ratios of first second and third displays which together constitute a display cycle. The duration ratio of the first, to the second, to the third display are 4:5:1 and correspond to inhalation, exhalation and resting respectively.

When there is a requirement to use the device, the user depresses the button 4 which sends a signal from the battery 20 to the anaylser 24 which forwards a signal to the power-up circuit 22 thus switching it on causing power to be supplied to the clock 26, the breaths per minute circuit 27 and the display circuit 30. Provided the button is released promptly, the analyser 24 will send a signal to the breaths per minute circuit 27 which will cause it to send a signal representing the display frequency from the display circuit frequency store 29 to the display circuit 30. The display circuit then combines the display frequency signal with a clocking signal from the clock 26 and the ratio information to generate signals which are transmitted along LED wires 32 to the LEDs 14 which are used to form the image 16 on the display means 6.

For the purposes of showing the manner in which the image 16 changes, the LEDs 14 shown in Figures 1 to 7 are shown shaded to represent an illuminated LED and blank to represent an unilluminated LED.

The display means will initially be blank as shown in Figure 1. A steady growth of an image 16 will then occur. First the column 8 (comprising one LED only) will be illuminated. Successive columns to its right will then additionally become illuminated until the full image shown in Figure 4 has been formed. This growth of the image 16 constitutes the first display, has a duration t1 and corresponds to a period during which the user should be inhaling.

Subsequently, column 12 is extinguished and then successive adjacent columns to the left of column 12 are extinguished one at a time. The image 16 passes through the states shown in Figures 5 and 6 and finally reaches the totally unilluminated state shown in Figure 1 again. This reduction of the image size constitutes the second display, has a duration t2 and corresponds to a period during which the user should be exhaling.

Subsequent to the second display, the display means 6 remains unilluminated as shown in Figure 1 for a period t3. This unilluminated state constitutes the third display and corresponds to a period in which the user should be pausing before recommencing inhalation.

The display circuit calculates the duration of t1, t2 and t3 such that:

(a) $t1 : t2 : t3 = 4 : 5 : 1$

(b) $(t1 + t2 + t3)\, f = 60$

where the periods are in seconds and f is the display frequency in breaths per minute.

If there is a requirement to obtain the display frequency f itself then the button is depressed for a prolonged period, such as 3 seconds, after which a single LED 34 will become illuminated and the display frequency f will be displayed in numeric form. The display means 6 in Figure 7 shows a display frequency of 10 being displayed.

The steps employed by a user to firstly ascertain his or her own relaxed breathing rate and secondly input this information to the breaths per minute circuit 27 will be described below.

The button 4 is depressed for over 3 seconds until the analyser 24 sends a signal to the display circuit causing it to illuminate two LEDs 34 and 35. When this occurs, the button 4 is released which causes the analyser 24 to actuate a breaths per minute computation means 28 in the breaths per minute circuit 27. The user then depresses the button 4 briefly at the end of each of five successive exhalations. The resulting signals are routed by the analyser 24 to the breaths per minute computation means 28 which computes the number of

breaths which would be made by the user in a minute and display this number briefly on the display means.

The user then needs to enter this information into the breaths per minute circuit 27. This is effected by depressing the button 4 until a number constituting the display frequency appears on the display means and releasing the button immediately. This number is changed to the measured number of breaths per minute by quick depressions of the button which results in signals being sent via the analyser 24 to the breaths per minute circuit 27. When the measured number of breaths per minute appears on the display means 6 the button 4 is left released for a while. This results in the display frequency f being calculated by the breaths per minute computation means 28 (the measured number of breaths per minute minus 1) and stored in the display cycle frequency store 29.

The device is then ready for the individual to use.

Should the user's relaxed breathing rate change or the device be used by another user, the display frequency can be easily altered using the technique set out above.

As an alternative to measuring and subsequently inputting a relaxed breathing rate, the device could be adapted to calculate and store the display frequency directly from the information input during the measurement of the relaxed breathing rate of the user.

Claims

1. Therapeutic device (1) for assisting in the lowering of a user's breathing rate the device comprising display means (6,14) and control means (18) adapted to operatively control the display means (6,14) so that it generates a repeating display cycle, each cycle including a first display followed by a second display corresponding respectively to periods of user inhalation and exhalation.

2. A therapeutic device according to claim 1 wherein the control means (18) includes means to control the display means (6,14) so that each display cycle it generates further includes a third display which occurs after termination of the second display and before commencement of the subsequent first display and corresponds to a user rest period between exhalation and inhalation.

3. A therapeutic device according to claim 1 or 2 further including adjusting means (4,24,27,28,29) for adjusting the period of display cycles generated by the control means (18).

4. A therapeutic device according to claim 1, 2 or 3 wherein the control means (18) is able to provide information in character form on the display means (6,14) concerning the display cycle.

5. A therapeutic device according to claim 4 wherein the information in character form comprises a number of display cycles per minute stored in the control means (18).

6. A therapeutic device according to any preceding claim wherein the control means (18) includes ratio information storage means (30) which ratio information is used to determine the ratio of a duration of the first display to that of the second display.

7. A therapeutic device according to claim 6 wherein the duration of the second display is longer than that of the first display.

8. A therapeutic device according to claim 2 or any claim dependent thereon wherein in each cycle: the first display unit lasts for between 30% and 50%; the second display lasts for between 40% and 60%; and the third display lasts for Between 5% and 15% of the display cycle time.

9. A therapeutic device according to claim 8 wherein in each cycle: the first display lasts for substantially 40%; the second display lasts for substantially 50%; and the third display lasts for substantially 10% of the display cycle time.

10. A therapeutic device according to any preceding claim wherein the first display comprises a representation which grows and the second display comprises a shrinking of the representation.

11. A therapeutic device according to claim 10 wherein the growing and shrinking occurs in a gradual or stepped manner.

12. A therapeutic device according to claim 10 or 11 wherein the representation includes adjacent strips at least some of which differ in length.

13. A therapeutic device according to any preceding claim wherein the device is adapted to be held in a user's hand.

14. A therapeutic device according to claim 10 or 11 wherein the representation comprises a bar-like image.

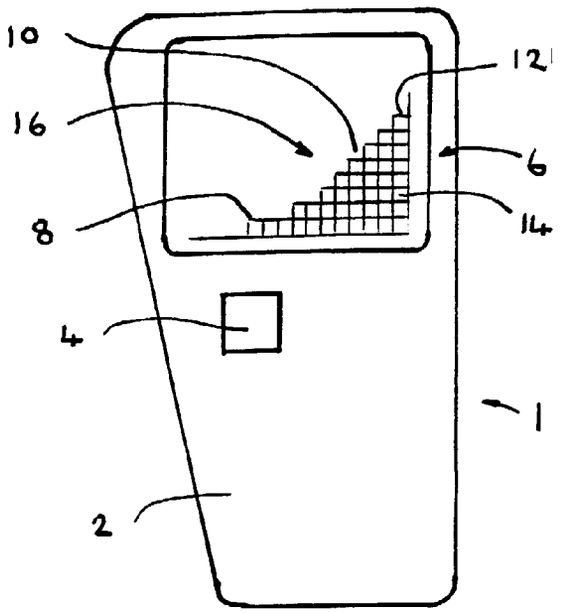

FIG.1

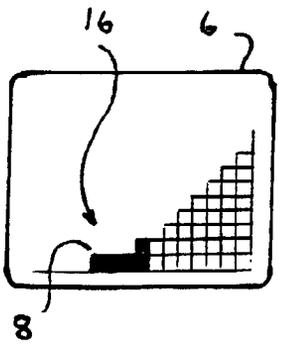

FIG.2

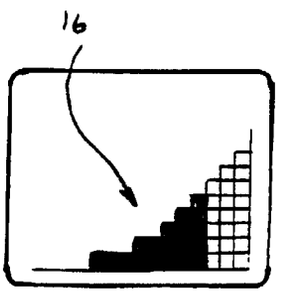

FIG.3

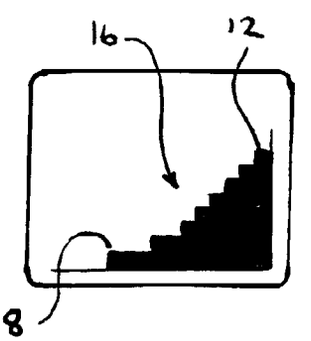

FIG.4

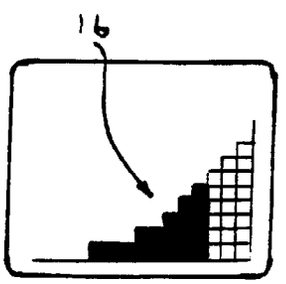

FIG.5

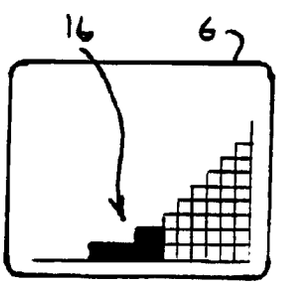

FIG.6

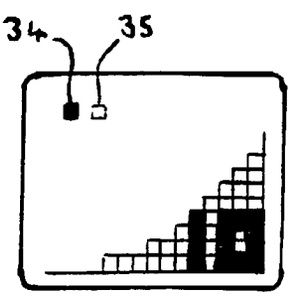

FIG.7

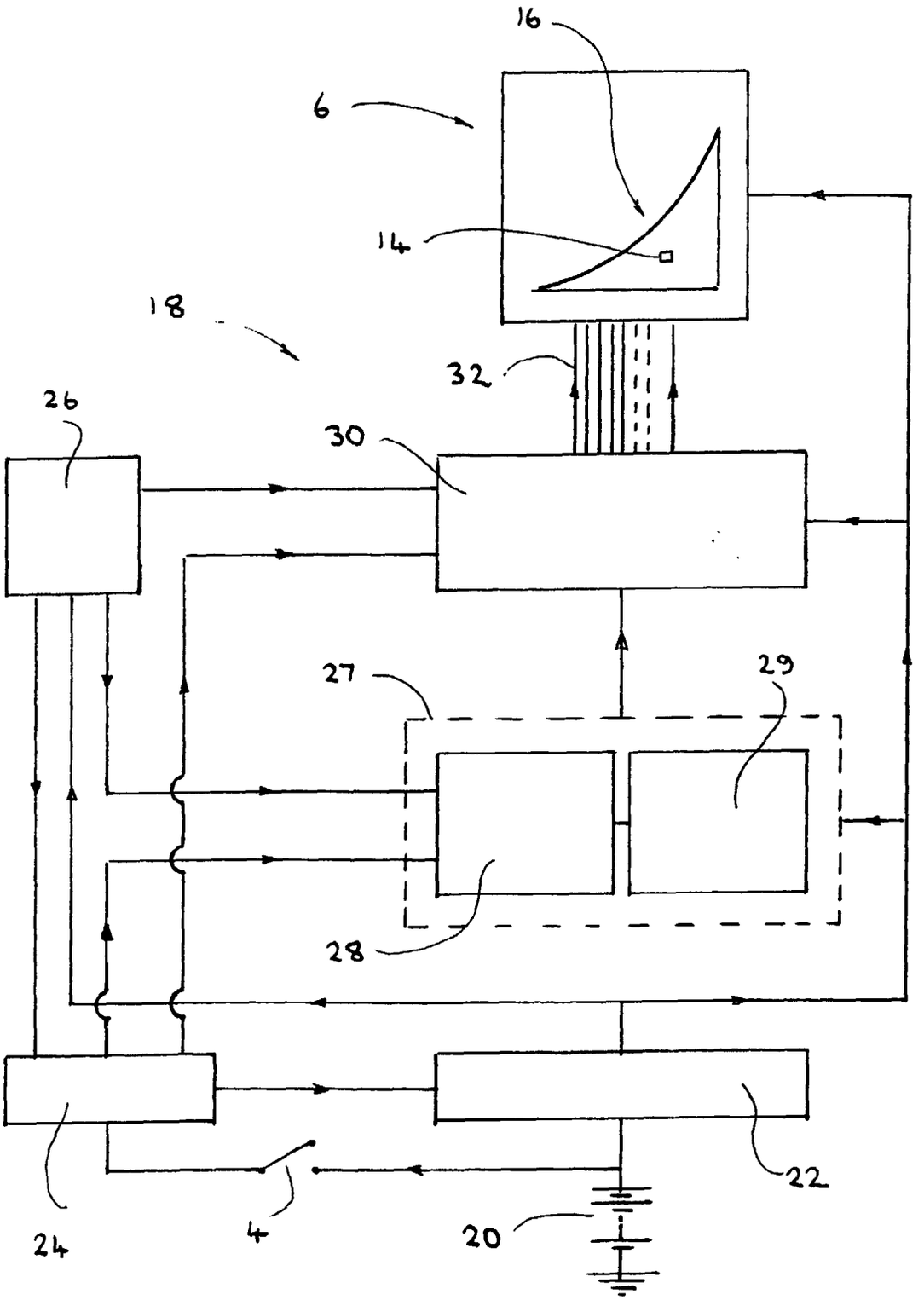

FIG. 8