

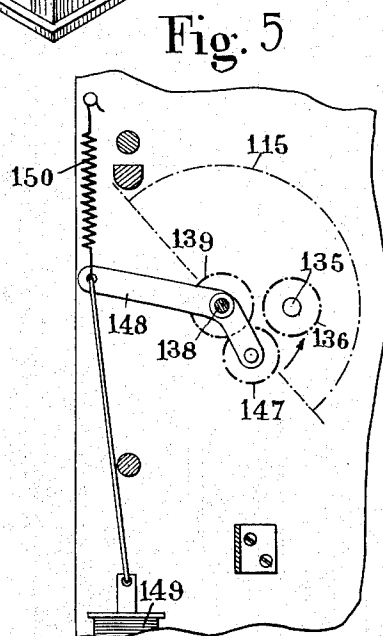
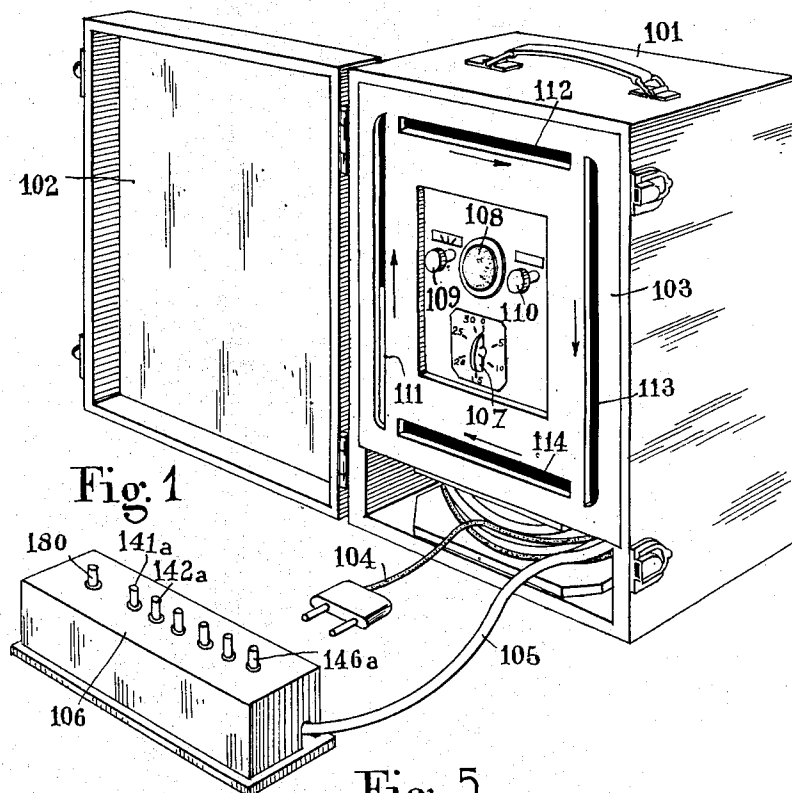
Nov. 23, 1965

E. GIORDANO
APPARATUS FOR IMPOSING A RESPIRATION CYCLE
ON A PATIENT, AND IN PARTICULAR TO
INDUCE PSYCHOSOMATIC RELAXATION

3,219,028

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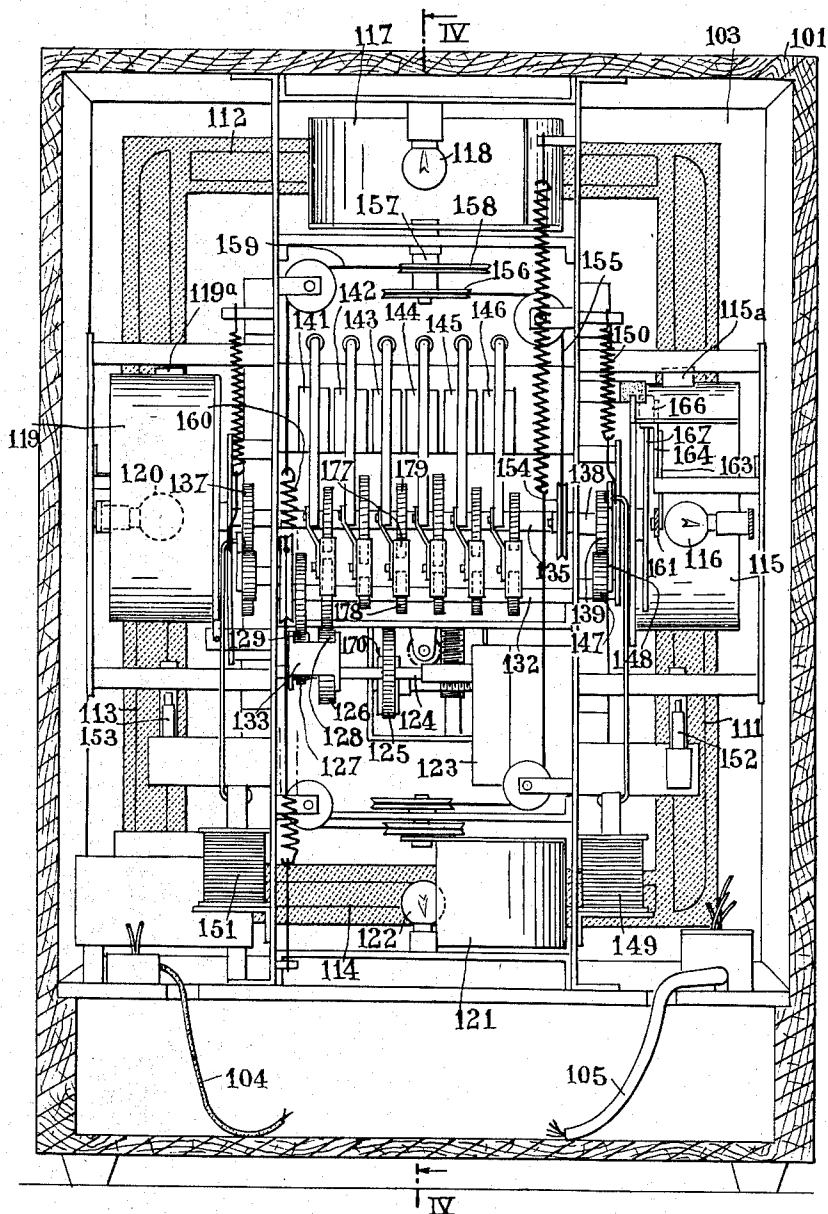


Fig. 2

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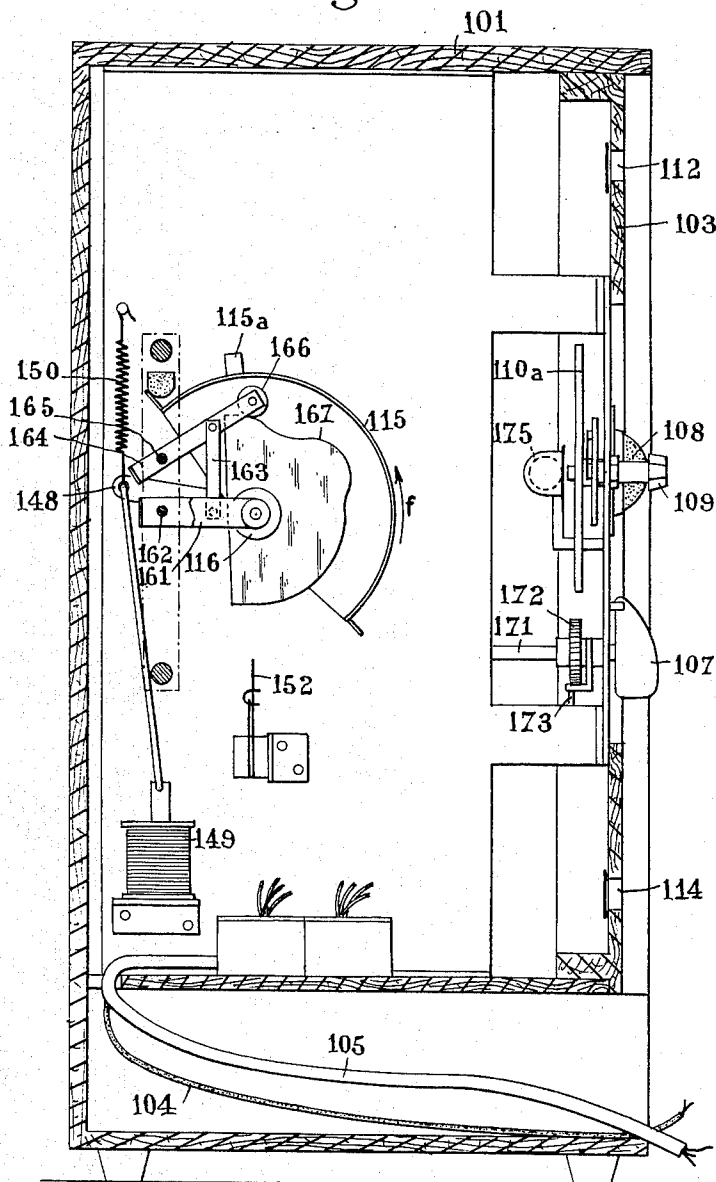
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Fig. 3



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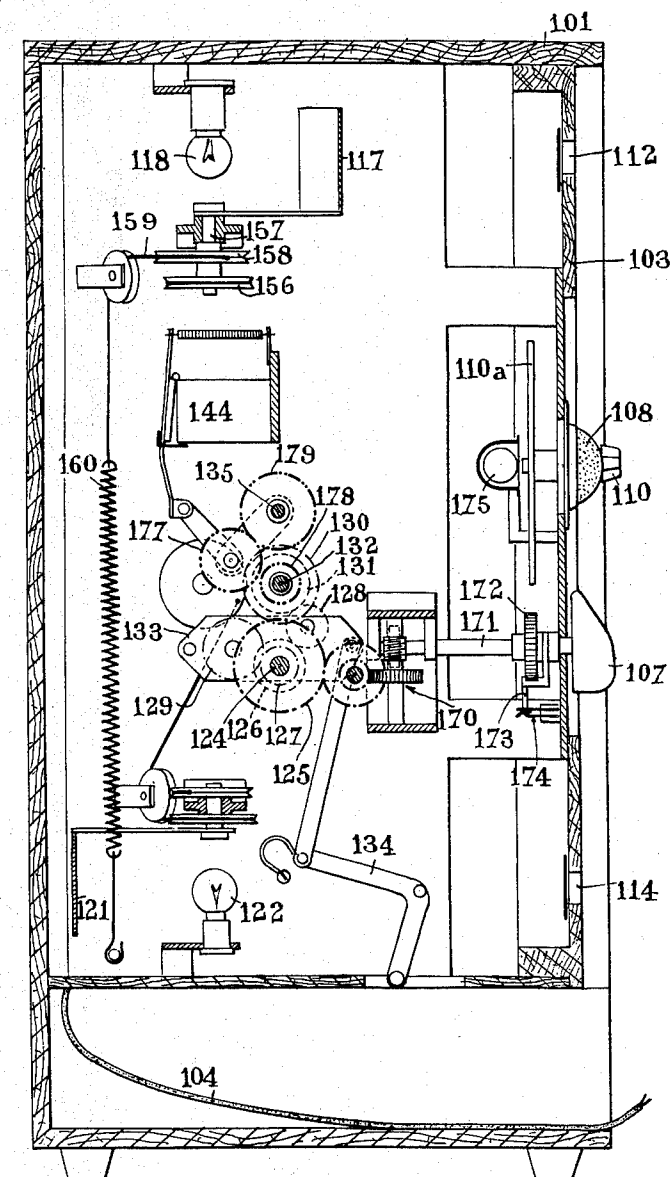
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Fig. 4



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Fig. 7

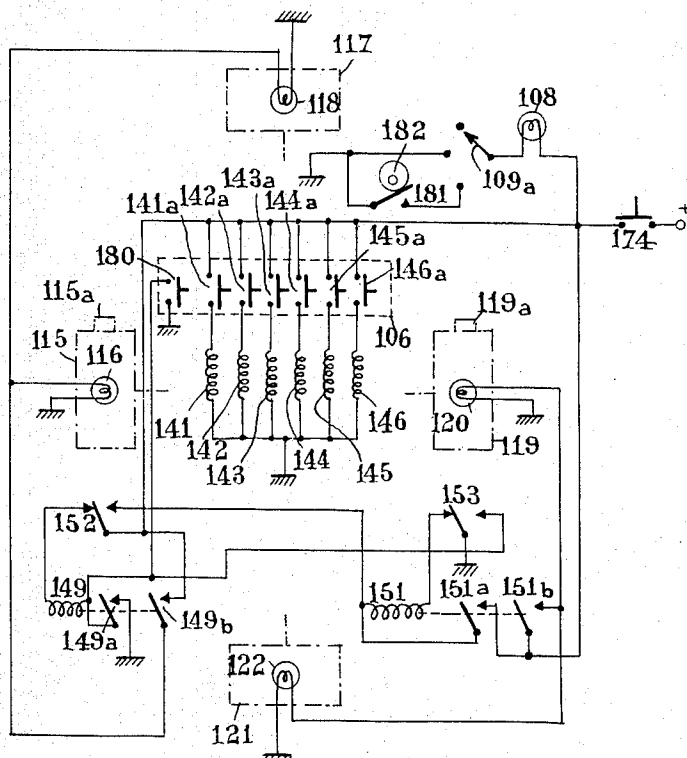
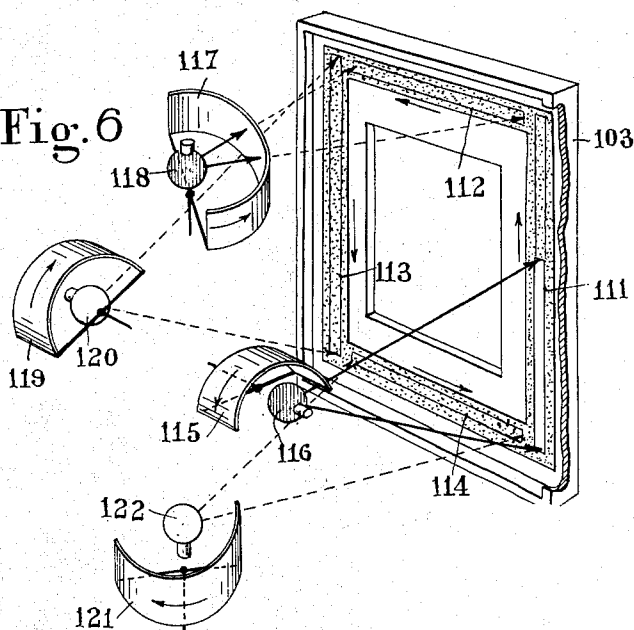


Fig. 6



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APPARATUS FOR IMPOSING A RESPIRATION CYCLE ON A PATIENT, AND IN PARTICULAR TO INDUCE PSYCHOSOMATIC RELAXATION

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8 Claims. (Cl. 128—1)

The present application is a continuation-in-part of my copending application Serial No. 64,777, filed on October 25, 1960, entitled: "Apparatus for Imposing a Respiration Cycle on a Patient, and in Particular to Induce Psychosomatic Relaxation," now abandoned.

This invention relates to an apparatus for imposing a respiration cycle on a patient and in particular to induce psychosomatic relaxation.

The natural human physiological rhythm is about 15 cycles per minute for a ventilation of 300 to 500 cubic centimeters per cycle, namely, 5 to 7 litres of air passed through the lungs in one minute.

In all psychosomatic methods such as relaxation, painless childbirth, etc., the aim is, on the one hand, to assist mental and physical relaxation by gradually slowing down the breathing rhythm, awareness of the change in rhythm being ensured by means of periods during which the breath is held, and, on the other hand, as the rhythm gradually slows down, to compel oneself to breathe more deeply and more amply, so as to produce a lung ventilation that is greater than the natural automatic ventilation.

Pieces of apparatus of this type have been resorted to before, in which provision is made for the displacement of a luminous spot in a to-and-fro linear motion, the patient adjusting the rhythm of his breathing to displacement of the spot. Displacement of this spot is obtained by mechanical means ensuring the alternating translation, of an assembly consisting mainly of a lamp and a screen, behind a slit in the apparatus.

An apparatus of the type described above has the drawback that displacement of the spot takes place in continuous fashion, so that the patient is able only to alternate inhalation and exhalation phases. For certain applications, however, it is necessary to provide, between the exhalation phase and the next inhalation phase (or vice-versa), a phase during which the patient holds his breath.

The chief object of the present invention is to provide an apparatus permitting visualization of a full respiration cycle in which the breath-holding phases are inserted between the inhalation and exhalation phases.

It is yet a further object of the invention to provide an apparatus in which the luminous trace which a patient must follow with his eyes may have any desired geometrical pattern differing from a straight line section.

The description which follows with reference to the accompanying drawing of the present invention will give a clear understanding of how the latter may be performed.

In the drawing:

FIGURE 1 is a perspective view of the front face of the apparatus.

FIGURE 2 is a rear elevation view of the apparatus the casing being assumed to have been removed.

FIGURE 3 is a side elevation view as seen from the righthand side of the apparatus, the lateral panel of the casing being assumed to have been removed.

FIGURE 4 is a vertical sectional view taken through the lines, IV—IV of FIG. 2.

FIGURE 5 is a fragmentary and highly diagrammatic view of the device used to drive one of the mobile screens.

FIGURE 6 is a simplified perspective view illustrating the manner of operation of the apparatus; and

FIGURE 7 is an electrical wiring diagram.

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Referring to FIGURES 1 to 7, the embodiment of the apparatus shown thereon basically comprises a casing 101 closed by a cover 102. When the apparatus is open (see FIG. 1), it will be seen that its front portion is equipped with a board 103 on which the luminous images appear, and, below said board, with a compartment housing the supply lead 104 and a conductor 105 connected to the remote control device 106. At the center of board 103 are positioned a timer control knob 107 and a luminous source 108 providing intermittent or continuous light adapted to be placed in circuit or not by means of a knob 109. A further knob 110 controls a filter selector to allow the color of the luminous source to be changed.

Said board 103 is provided with windows, to wit, two vertical windows 111 and 113 and two horizontal windows 112 and 114 which form a rectangle. These windows can obviously be arranged differently if desired. Window 111 is associated to the inhalation phase of the breathing cycle and window 113 to the exhalation phase, while windows 112 and 114 are associated to the breath-holding phases between inhalation and exhalation.

Referring now to FIGURES 2, 3 and 4, it will be seen that behind windows 111 to 114 are respectively positioned assemblies consisting of semi-cylindrical screens 115, 117, 119 and 121 on the one hand, and lamps 116, 118, 120 and 122 on the other hand. The lamp 116 illuminates window 111 and the light rays from said lamp can be occluded by mobile screen 115. Similarly, lamps 118, 120 and 122 respectively illuminate windows 112, 113 and 114, the light rays from which lamps can be occluded by screens 117, 119 and 121.

The various moving parts of the apparatus are driven by a motor/reduction gear 123, the output shaft 124 of which mounts a first pinion 125 coupled in driving relation to said timer (which timer will be described in greater detail hereinafter) and two further driving pinions 126 and 127 which transmit the motion through intermediate pinions 128 and 129 to driven pinions 130 and 131 rigid with intermediate shaft 132. Said intermediate pinions 128 and 129 are mounted on a pivotal support 133 controlled by a linkage system which is generally designated by reference numeral 134 (see FIGURE 4), thereby allowing for the selection of either of two transmission ratios between drive shaft 124 and intermediate shaft 132.

Each of a plurality of speed selection electromagnets 141 and 142 . . . 146 controls the motion of an intermediate pinion 177 which, when the corresponding electromagnet is energized, is brought into mesh with a pair of pinions 178 and 179 which are respectively rigid with intermediate shaft 132 and driving shaft 135. In the specific example considered for illustrative purposes, wherein it is possible to select either of six operating speeds, i.e. six different respiration cycle times, intermediate shaft 132 and driving shaft 135 support six pairs of meshing pinions such as pinions 178 and 179. Driving shaft 135 is thus rotated by intermediate shaft 132 at a relative speed which will depend on whichever of electromagnets 141 to 146 is energized, or, more precisely, on the pitch circle diameters of pinions 177, 178 and 179 associated to that particular electromagnet.

On its extremities, driving shaft 135 carries two pinions 136 and 137, which are respectively adapted to rotate the cylindrical screens 115 and 119. A description will now be given, with particular reference to FIGURE 5, of the mechanism for driving one of the horizontal-axis cylindrical screens. Screen 115 is rigid with a shaft 138 onto which is keyed a pinion 139 meshing with an intermediate pinion 147. Said intermediate pinion is mounted on one of the arms of a pivotal lever 148 fulcrumed about the shaft 138. The pivotal motion of lever 148 is controlled by an engagement electromagnet 149 which is biased by

a return spring 150. When electromagnet 149 is energized, it pivots lever 148 in an anticlockwise direction with reference to FIGURE 5 and shifts intermediate pinion 147 into engagement with pinion 136, thereby causing the rotation of driving shaft 135 to be transmitted to the shaft 138 of drum 115 through the instrumentality of pinions 136, 147 and 139.

The clutch or engagement mechanism of the other cylindrical screen 119 is identical to this clutch mechanism and is controlled by an electromagnet 151. When they reach the end of their travel, cylindrical screens 115 and 119 operate through pegs 115a and 119a on reversing contacts 152 and 153, the functions of which will be specified in greater detail when the electrical wiring diagram of the apparatus is examined hereinbelow.

Semi-cylindrical screens 115 and 119 respectively drive the vertical-axis semi-cylindrical screens 117 and 121 through a cable and pulley system. As may be seen in FIGURE 2, the shaft 138 of drum 115 is rigid with a pulley 154 over which runs a cable 155, which cable also runs over a pulley 156 rigid with the vertical shaft 157 of screen 117. A second pulley 158 is keyed to said shaft 157, and this pulley cooperates with a cable 159 fastened to a return spring 160. Pulleys 156 and 158 are mounted eccentrically on shaft 157, in such a manner that the rotation of screen 117 produces a substantially constant rate of displacement of the illuminated section of window 112.

In like manner, semi-cylindrical screen 119 controls the motion of screen 121 through a similar combination of component parts.

In order to insure a constant rate of displacement of the illuminated section of windows 111 and 114, it will be of advantage, as shown in FIGURE 3, to mount lamps 116 and 120 on a stirrup 161 which pivots about a shaft 162. Said stirrup 161 is connected by a link 163 to a lever 164 which pivots about shaft 165 and supports a follower 166, which follower cooperates with a cam 167 which is angularly rigid with cylindrical screen 115. As a result of this disposition, when drum 115 rotates, the arm 161 carrying lamp 116 has imparted to it an oscillating motion which is designed to compensate for fluctuations in the rate of travel of the illuminated window area and cause it to remain substantially constant.

As stated precedingly, the apparatus is equipped with a timer which is driven, through the medium of a transmission gear train generally designated by reference numeral 170 on FIGURE 4, by the pinion 125 rigid with driving shaft 124. The output shaft 171 supports a pinion 172 which controls the pivotal motion of a peg 173 which operates a master limit switch 174.

The light source 108 (see FIGURE 4) comprises a lens which is illuminated by a lamp 175 positioned behind a colored filter support 110a which can be rotated by means of a knob 110.

The apparatus according to this invention will now be described with particular reference to the schematic illustration of FIGURE 6 and the electrical wiring diagram of FIGURE 7. Having placed the timer knob 107 in the position corresponding to the required duration of the exercise and the master switch 174 being closed, the operator presses one of push-buttons 141a, 142a . . . 146a of the remote control device 106, according to whichever of electromagnets 141, 142 . . . 146 is to be energized. To each pushbutton 141a to 146a there corresponds a fixed respiratory cycle duration. If pushbutton 141a is depressed, electromagnet 141 will be energized and the intermediate pinion 177 associated thereto will transmit the motion through the corresponding pinions 178 and 179, thereby causing driving shaft 135 to be driven off the input shaft 124 with the chosen demultiplication ratio.

To initiate operation, the operator must press an additional pushbutton 180 which is associated to the remainder of pushbuttons 141a to 146a in the remote control

unit 106. Closure of contact 180 causes electromagnet 149 to be energized, since contact 172 is in the inoperative position. Contacts 149a and 149b of electromagnet 149 then close, the former of said contacts insuring continued energization of electromagnet 149 and the latter switching the current supply through to lamps 116 and 118. Thenceforward, these two lamps will emit light rays which, however, will be occluded by the respective screens 115 and 117.

As explained precedingly, energization of engagement electromagnet 149 results in the shaft 138 of semi-cylindrical screen 115 being set in rotation, thereby causing the latter to be rotated in an anticlockwise direction with reference to FIGURE 3. During this motion, lamp 116 is progressively unmasked and a luminous area of progressively increasing height is projected on the vertical window 111.

When the lighted section of window 111 has progressed to the upper extremity of said window, the semi-cylindrical screen 117, which is rotated at the same time as screen 115, begins to unmask lamp 118, which lamp then begins to project a beam of light on to the horizontal window 112, this beam in turn producing a progressively increasing illuminated section. When this latter section has reached the extremity of window 112, screen 115 acts on contact 152 through peg 115a and causes it to move into its operative position. If reference be now had to FIGURE 7, it will be seen that rendering contact 152 operative causes energization of the second engagement-electromagnet 151 associated to screen 119. This change of state of contact 152 furthermore cuts off the continued energization of electromagnet 149 and thereby causes extinction of lamps 116 and 118. At the same time, semi-cylindrical screens 115 and 117 revert to their inoperative positions in response to return springs 160.

Excitation of engagement-electromagnet 151 results in closure of contacts 115a and 151b, the former of which contacts controls continued energization of electromagnet 151 when contact 153 is in its inoperative position and the latter switches through the current supply to lamps 120 and 122. Simultaneously, engagement electromagnet 151 causes rotation of screen 119 and correlative rotation of screen 121. In their inoperative positions, screens 119 and 121 are so disposed that they do not occlude the light rays from lamps 120 and 122, so that as soon as contact 152 is transferred to its operative position by screen 115, the lamps 120 and 122 illuminate the entirety of windows 113 and 114. Simultaneously, lamps 116 and 118 are extinguished, thereby causing the illuminated sections of windows 111 and 112 to disappear.

Semi-cylindrical screen 119 then begins its rotational motion and progressively occludes the light rays from lamp 120, thereby causing an area of increasing darkness or decreasing illumination to appear on window 113, the progression taking place in a downward direction. Thus, the illuminated area gradually decreases and, when it has reached the bottom extremity of window 113, semi-cylindrical screen 121 in turn begins to occlude the light rays from lamp 122, thereby causing the illuminated area of window 114 to gradually diminish until complete extinction. When the initial starting position is reverted to in this way, peg 119a of screen 119 moves contact 153 into its operative position, and the initial effect of this is to cut off the energization of electromagnet 151 and to thereby cause screen 119 to be released. Screen 119 and screen 117 then revert to their inoperative positions in response to their return springs. In addition, opening of contact 151b causes the supply to lamps 120 and 122 to be cut off. Lastly, the transition of contact 153 to its operative position causes the first engagement electromagnet 149 to be energized and rotation of screen 115 to be resumed, thus beginning a fresh cycle.

It will be seen, therefore, that in windows 111, 112, 113 and 114, which are respectively associated to the inhala-

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tion, breath-holding, exhalation and breath-holding phases of the breathing cycle, there appear progressively increasing or decreasing illuminated areas, as the case may be. The patient then matches his breathing rhythm to the rate of progression of these luminous images and is free to choose the frequency of image succession, i.e. the duration of the breathing cycle, by energizing the appropriate electromagnet 141 to 146.

The time base of the various cycles can very easily be modified by changing the transmission ratios of the various pinion assemblies. It is also possible to effect two- or three-stage respiration cycles by changing the board 103 and modifying the settings of the semi-cylindrical screen.

Reference is now had to FIGURE 7, in which it will be seen that knob 109 controls a selector 109a adapted to place the winking lamp 108 out of circuit, to supply it with constant current, or to place it in series with a contact 181 controlled by a cam 182 which is rotated by the input shaft to produce the winking effect.

Similarly, the apparatus can be equipped with a knob to enable the brightness of the various light sources to be adjusted to suit the surrounding lighting conditions.

What I claim is:

1. An apparatus for imposing a respiration cycle consisting of successive inhalation, breath-holding, exhalation and breath-holding phases, respectively, in particular for inducing psychosomatic relaxation, comprising an electric motor, a board, first illuminating means thereon to indicate the inhalation phase of the respiration cycle to the patient, second illuminating means on said board to indicate a breath-holding phase of the respiration cycle to the patient, third illuminating means on said board to indicate an exhalation phase of the respiration cycle to the patient, fourth illuminating means on said board to indicate a breath-holding phase of the respiration cycle to the patient, said first, second, third and fourth illuminating means consisting of illuminated areas the dimensions of which vary continuously and being so arranged in succession as to form a substantially continuous trace on said board, each of said illuminating means comprising in conjunction with each illuminated area, a light source, a screen for occluding the light therefrom and means for moving said screen by said electric motor in relation to said source so that a continuously varying illuminated area be projected on said board.

2. An apparatus as claimed in claim 1, wherein said illuminating means comprises a plurality of elongated windows each of which is associated with a phase of the respiration cycle respectively, and, behind each one of

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said windows, a semi-cylindrical screen, a lamp positioned within said semi-cylindrical screen, and means for rotating said screen about its axis so as to cause its shadow to be projected onto the associated window.

3. An apparatus as claimed in claim 2 wherein at least one window is vertical and the semi-cylindrical screen projecting a shadow thereon has a horizontal axis.

4. An apparatus as claimed in claim 2, wherein at least one window is horizontal and the semi-cylindrical screen for projecting a shadow onto said horizontal window has a vertical axis.

5. An apparatus as claimed in claim 2 comprising a mobile support for mounting each lamp projecting the shadow of its associated semi-cylindrical screen and a cam for so moving said mobile support that the rate of travel of the illuminated area on said board be substantially constant.

6. An apparatus as claimed in claim 2, comprising a timer driven directly by said electric motor, a driving shaft, a plurality of coupling means providing different transmission ratios interposed between said motor and said driving shaft, speed engagement electromagnets each of which controls one of said coupling means, and means for rotating the semi-cylindrical screens from said driving shaft.

7. An apparatus as claimed in claim 6, comprising means whereby the semi-cylindrical screen producing an illuminated area associated with one of the phases of the respiration cycle rotates that semi-cylindrical screen which produces the illuminated area associated with the next phase of the respiration cycle.

8. An apparatus as claimed in claim 6, comprising a remote control device which consists of a starting button and a plurality of push-buttons respectively associated with a different duration of the respiration cycle and which selectively controls the energization of said speed engagement electromagnets, and means for energizing a semi-cylindrical screen coupling electromagnet when said starting button is depressed.

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