

[54] **PHYSIOTHERAPY CONTROL DEVICE**

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[51] Int. Cl.**G06m 3/02**

[58] Field of Search235/92 RE, 92 T, 235/92 CT, 92 CC; 340/31, 41, 309.4, 168 C, 325

[56] **References Cited**

UNITED STATES PATENTS

3,613,074 10/1971 Hill.....340/31 A

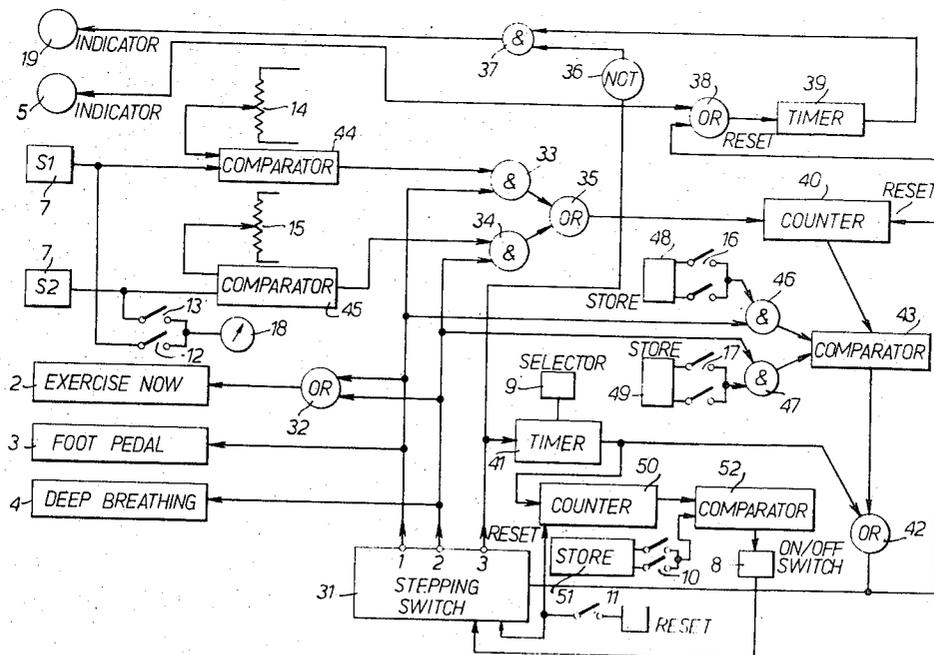
2,889,987 6/1959 Marcus.....235/92 PE

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[57] **ABSTRACT**

The physiotherapy control device described herein includes means for instructing a patient to perform a particular exercise, means for counting the number of times the exercise has been properly performed, and when a predetermined count has been reached for then instructing the patient to perform a different exercise, means for counting the number of times the exercise has been properly performed, and when a predetermined count has been reached for instructing the patient to rest. After a predetermined time the cycle is repeated and the operation is terminated after a predetermined number of cycles.

5 Claims, 3 Drawing Figures



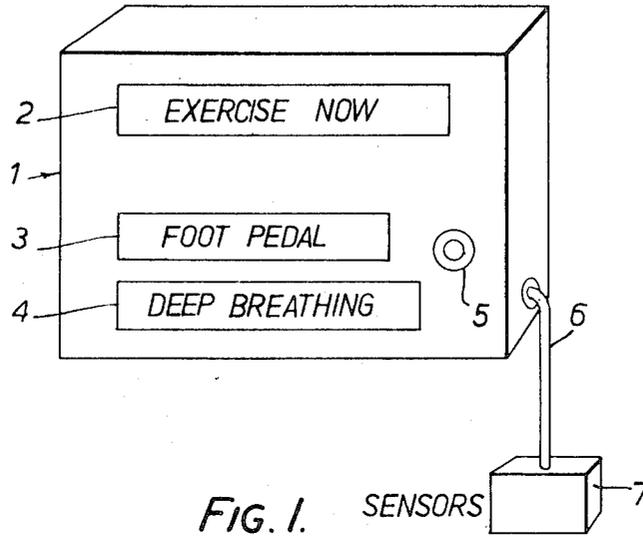


FIG. 1.

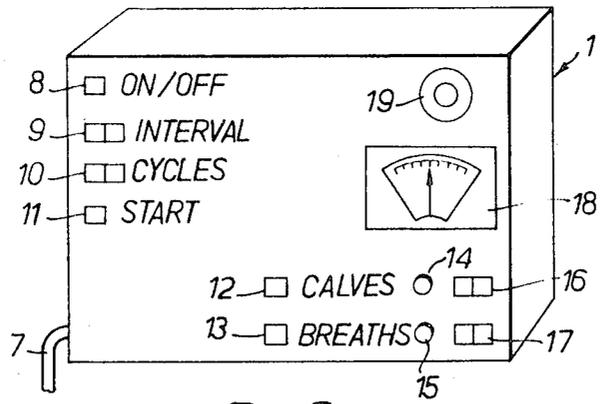


FIG. 2.

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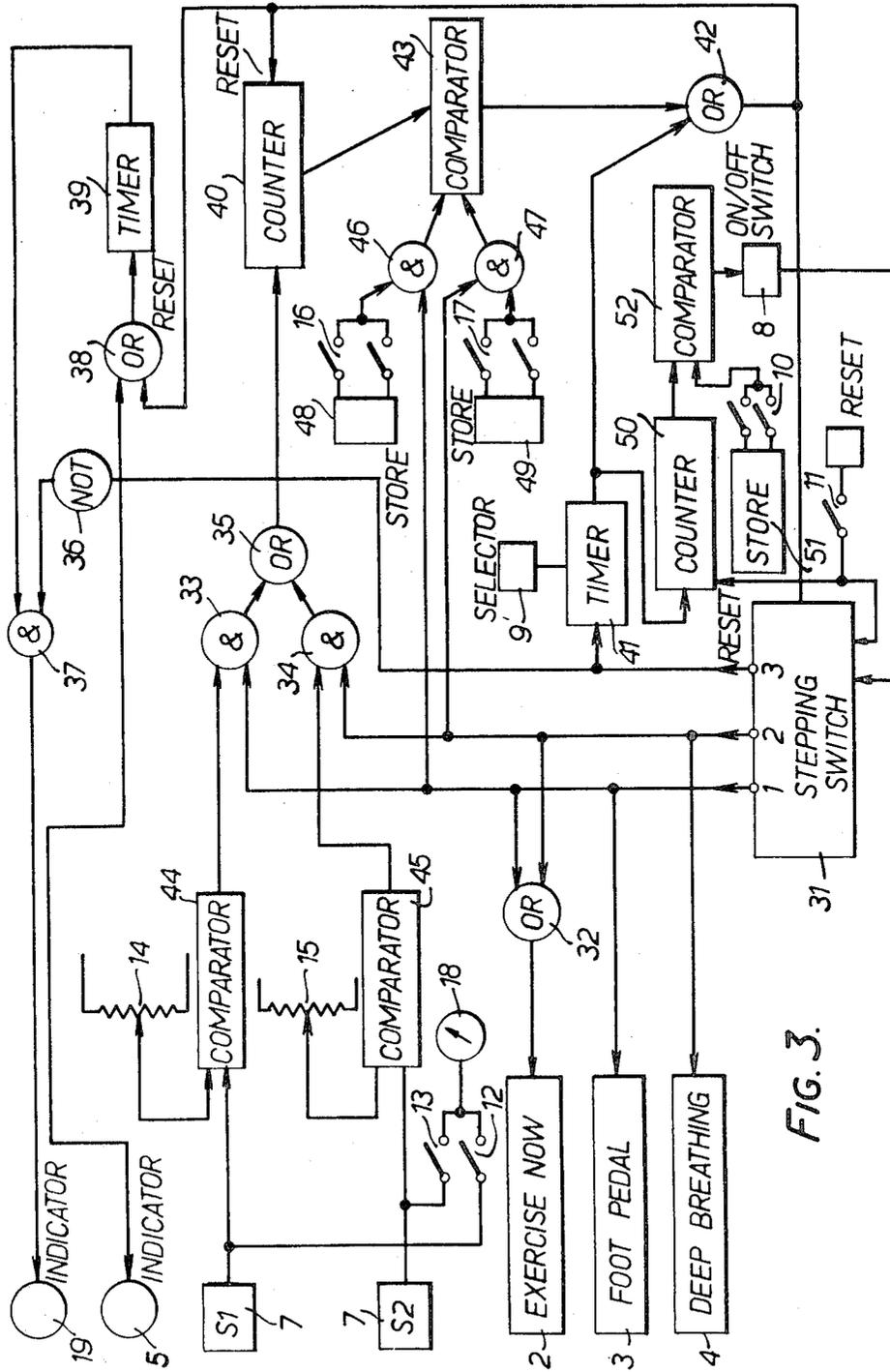


FIG. 3.

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PHYSIOTHERAPY CONTROL DEVICE

This invention relates to physiotherapy control devices.

It is an object of the present invention to provide an improved device for monitoring and instructing patients who are engaged in performing physiotherapy exercises.

A physiotherapy control device including a stepping register, an input terminal to which a sensor may be connected, a comparator for providing an output signal when the signal from said sensor exceeds a predetermined level, means enabled when said register is in a first one of its states to apply said output signal to a counter, means for stepping said register into a second state when the count registered by said counter reaches a predetermined value, a timer enabled when said register is in its second state, means for stepping said register into another of its states when a predetermined time measured by said timer has elapsed, and indicating means to indicate the state of said register.

One of the duties of a physiotherapist is to show patients how to perform exercises after operation, but many patients do not perform their exercises unless they are supervised or repeatedly asked to do so. The device described herein may be mechanical, fluidic, pneumatic, electrical, or electronic and is intended to supervise the patients exercises. The device described herein comprises four main parts. The first part, a communication device presents on an illuminated panel or otherwise an instruction to the patient (for example "EXERCISE NOW"). The second part, a sensing device, measures the time and/or quantity and/or quality of exercise. The third part switches off the instruction to the patient when a signal is received from the second part to the effect that a pre-set amount of exercise has been performed. The fourth part is a time switch which switches on the instructions to the patient after a pre-set interval or intervals. Controls are provided for the physiotherapist to measure and/or display and/or record the amount of exercise and to set the frequency and/or duration of instructions. A common use in practice would be for the physiotherapist (a) to show a patient how to perform exercises, (b) to measure the quantity of exercise for a given time, (c) to store this quantity as a standard, and (d) to set the frequency of signals to the patient. The machine at set intervals would then communicate with the patient and continue these instructions until the patient had performed the necessary exercises. Display, measurement and recording facilities can be provided as additional equipment if required. Thus the device encourages, supervises and controls the amount of exercise which a patient performs. Facilities can be provided for centralization of controls and programming to serve several patients or for supervision of particular muscles or muscle groups.

Features and advantages of the invention will become apparent from a study of the following description of examples thereof, given by way of example, taken in conjunction with the accompanying drawings in which:

FIG. 1 shows a view of a device according to one embodiment of the invention,

FIG. 2 shows another view of the device shown in FIG. 1, and

FIG. 3 shows in block form the circuitry contained in the device shown in FIGS. 1 and 2.

The embodiment of the physiotherapy control device described herein comprises the case 1 shown in FIGS. 1 and 2. FIG. 1 shows the view of the device as seen by the patient performing the physiotherapy exercises and FIG. 2 shows the view of the device as seen by the nurse in charge of the exercises.

Referring to FIG. 1, the device comprises a box 1. On the front there are three panels 2, 3, and 4 having the captions "EXERCISE NOW" "FOOT PEDAL" and "DEEP BREATHING" respectively. Normally the captions cannot be read but sources of light are provided behind them so that when a respective source is energized the caption can be read by the patient. An indicator lamp 5, preferably green, is also provided on the front panel of the device. A cable 6 connects the circuitry inside the case to sensors indicated by the block 7. The sensors when the device is to be used in conjunction with calf exercises and deep breathing exercises are a pedal ergometer and a band held spirometer such as the Greer manometer respectively. It will be appreciated however that if other exercises are to be controlled then appropriate sensors 7 would be employed and the captions 3 and 4 would be suitable chosen.

Referring to FIG. 2 which shows the rear side of the device, there are provided on said rear panel an on-off switch 8, two switches 9 for selecting two different time intervals of rest between the two different kinds of exercise, two switches 10 for selecting two different numbers of cycles of sets of exercises before the device switches off, and a switch 11 for starting the operation of the device. The panel also displays an indicator light 19, preferably red, and a meter 18 for indicating the amplitude of response from either of the sensors selected by the switch 12 or the switch 13. The adjusting knobs 14 and 15 control reference levels relevant to the two sensors and which set the standard to be achieved by the respective exercises. The two switches 16 are for selecting one of two different numbers of exercises which are to be performed in any one cycle of calf exercise and similarly the switches 17 serve the same function for the breathing exercises. It will be appreciated that the switches 9, 10, 16, and 17 in the example described herein allow for the setting of two different values of the respective quantities. It will be evident to those skilled in the art that in alternative embodiments of the machine a greater number of selections could be provided or alternatively a continuous selection could be provided so as to yield an almost unlimited choice of quantities.

The operation of the device will now be summarized.

SETTING UP PROCEDURE

1. Press "on" switch.
2. Select first sensor for test.
3. Examine the standard of exercise, as shown on the meter, and set the quantity or standard (e.g. vital capacity, peakflow) to be achieved by the individual patient.
4. Set the number of times this standard has to be attained (e.g. 20 breaths).
5. Repeat for second sensor.
6. Set time interval between exercises (e.g. 30 mins)
7. Set number of cycles or times to be performed each day (e.g. 20)
8. Press start switch.

CYCLE OF OPERATIONS

1. Panel "exercise now" and "footpedal" lit.
2. Patient depresses foot pedal hard enough to achieve standard as indicated by the green light on the patient's side of the box.
3. Patient repeats exercise until set number of times (green light with each one) has been attained.
4. The panel "footpedal" is then extinguished and the panel "deep breathing" is lit.
5. Patient breathes into the spirometer hard enough to get the green light.
6. Patient repeats exercise until set number of times has been achieved.
7. All panels are then extinguished.
8. Cycle restarted after set interval and repeated as often as set number of cycles.
9. Machine switches itself off.
10. If standard of exercise is not reached at any time the red light on the nurses side of the box comes on and the nurse then encourages the patient to complete his exercise.

FIG. 3 shows in block form the circuitry contained in the device 1 and this will now be described. The device is effectively controlled by the sequentially operated device 31 which is a stepping switch having three positions. Alternatively the device 31 may be a shift register having three stages. It steps one position each time a pulse is applied to its input. The outputs appear at the terminals 1, 2, and 3 so that at any instant there is a voltage appearing at only one of the output terminals. The terminal 1 of device 31 is connected to the light source for illuminating the caption 3 (footpedal) and also to one input terminal of an OR-gate 32 and as one input of an AND-gate 33. The terminal 2 of device 31 is connected to the light source for illuminating the caption 4 (deep breathing), to another input terminal of the OR-gate 32, and to an input terminal of an AND-gate 34. The output of the OR-gate 32 is connected to the source of the illumination of the caption 2 (exercise now).

The sensors 7 are indicated by the two blocks s1 and s2, which as stated above may be respectively a pedal ergometer and a hand held spirometer. The outputs from the sensors are connected to respective comparators 44 and 45. The reference voltages supplied to said comparators are obtained respectively from potentiometers 14 and 15 connected to a voltage source and are controlled by knobs on the rear panel on the device as shown in FIG. 2. The outputs from said comparators are connected respectively to AND-gate 33 and 34. The outputs from the sensors 7 can be selectively connected by means of the respective switches 12 and 13 to a meter 18 so that the output level from said sensors may be examined preparatory to setting the respective reference levels on the potentiometers 14 and 15.

The outputs from the AND-gates 33 and 34 are connected to the two inputs of an OR-gate 35. The output from OR-gate 35 is connected to the indicator light 5, to a counter 40, and to an input terminal of an OR-gate 38. A reference store 48 is effectively a memory store which contains two different counts of the number of the chest exercises which are to be performed, either of which may be selected by one of the switches 16, also shown on the rear panel. The selected count is applied to an AND-gate 46. In a similar way a store 49 contains counts of the number of breathing exercises to

be performed and these are selected by the switches 17 and applied to an AND-gate 47. Output 1 of the device 31 is connected to serve as the other input of AND-gate 46 and the output from terminal 2 of device 31 is connected to serve as the other input of AND-gate 47. The outputs of AND-gate 46 and 47 are connected to a comparator 43 which compares the count in the counter 40 with that provided from one of the stores 48 or 49 to provide an input to an OR-gate 42 when the count in 40 reaches that indicated by a respective store 48 or 49. The output of OR-gate 42 is connected to the input of device 31 to step it along one place whenever an output is provided by said OR-gate.

The output 3 of the device 31 is connected to the input of a timer 41 to start it operating, and, after a predetermined time which can be controlled by the switches 9, to provide an input to the OR-gate 42. Said output 3 of device 31 is also connected through a NOT-gate 36 to an input of an AND-gate 37. The output of OR-gate 38 is connected as the re-set input to a timer 39 which is set to provide an output signal after a predetermined time. The output of the timer 39 is connected to serve as the other input of the AND-gate 37. The output of AND-gate 37 is connected to the warning light 19. Another output from the OR-gate 42 is connected to re-set the counter 40 and as an input to the OR-gate 38.

In order that the device shall stop after a predetermined number of cycles of exercise, a counter 50 is connected to the output of device 41. Each cycle of operation causes the counter to increase its count by 1. The counter is connected, like counter 40, to a store 51, selecting means 10 for selecting one or two counts from said store, and a comparator 52 to provide an output when a predetermined count is reached. The output from comparator 52 is connected to ON/OFF switch 8.

In order to commence operation of the device once again, a switch 11, preferably of press-button type, is provided which when closed applies a re-set signal to the counter 50 and to the device 31 to step into the condition in which terminal 1 is energized and the cycle then commences again.

In operation, supposing that the device 31 is in the condition when an output appears on terminal 1. Then the caption footpedal is illuminated, the caption exercise now is illuminated and a signal is applied to the AND-gate 33. As the patient operates the sensor s1 each time the device provides an output greater than the reference level set by the potentiometer 14 an input is provided to the other terminal of the AND-gate 33. This applies an input through the OR-gate 35 to the indicator light 5. This means that the indicator light seen by the patient flashes each time he has reached the predetermined level. The signal is also applied through the OR-gate 38 to reset the timer 39. If no signal emerges from the comparator 44 during an interval longer than that set by the timer 39, an input is applied by the timer 39 to the AND-gate 37, and since a signal is also applied from terminal 3 of device 31 through the NOT-gate 36 to AND-gate 37, an output is applied to the warning light 19. This serves to warn the nurse that the patient is not doing the exercise. The signal from the OR-gate 35 is applied to the counter 40 and the AND-gate 46 allows a reference signal to be applied from store 48 to the comparator 43. When the counter 40 reaches the count indicated by the store 48, an output

is provided by the comparator 43 which, through the OR-gate 42 steps the shift register 31 along one place and also resets the counter 40 and the timer 39.

An output now appears on terminal 2 of device 31 and the operation is similar to that occurring with the footpedal but now relates to deep breathing.

When the predetermined number of deep breathing exercises has been accomplished 31 shifts to the condition in which terminal 3 is energized. This initiates the timer 41 and also withdraws the enabling from AND-gate 37 through the NOT-gate 36.

After a time determined by the timer 41 controlled by the selector 9, a signal is applied to the OR-gate 42, and thence to the device 31 to shift the energization from terminal 3 to terminal 1 thereof and the cycle continues until the device is switched off by counter 50 acting via comparator 52 and store 51 on on/off switch 8.

It will be appreciated that numerous variations within the scope of the invention may be provided. For example whilst the instructions to the patient have been shown in the example described above as visual, they could equally be auditory, for example in the form of tape-recorded instructions. The device described above is a two channel one in which there are three stages in the cycle, namely two different exercise modes and a rest period. It will be obvious that various combinations may be provided for example by using only a single sensor or three or more sensors, and the rest interval may be made to occur between each exercise stage, or in any desired combination therewith.

What I claim is:

1. Physiotherapy apparatus for monitoring the repeated performance by a patient of a given physical task, comprising

- a. a stepping register (31) having at least two operating states and corresponding output terminals (1, 3);
- b. signal generator means including a sensor (7), a reference signal source (14) and a comparator (44) connected with the outputs of said sensor and said source for generating a task signal each time the patient performs satisfactorily the physical task;
- c. a counter (40);
- d. enabling means (33) for connecting said signal

generator means with said counter when said stepping register is in its first operating state;

- e. means (43, 38) for stepping said stepping register to its second operating state when the count contained in said counter reaches a predetermined value;
- f. normally disabled timer means (41) for establishing a predetermined time period;
- g. means (3) for enabling said timer means when said stepping register is in said second state;
- h. means (42) controlled by said timer means for stepping said stepping register to another operating state at the end of said predetermined time period; and
- i. register state indicating means connected with said stepping register for indicating the instantaneous state of operation thereof.

2. Apparatus as defined in claim 1, and further including performance indicating means (5) for providing an indication each time a patient performs satisfactorily a given task.

3. Apparatus as defined in claim 1, and further including normally disabled warning indicating means (19), and means including a second timer (39) for enabling said warning indicating means when said stepping register means is in said first operating state and said signal generator means has not generated a task signal for a given period of time.

4. Apparatus as defined in claim 1, wherein said stepping register includes a third operating state and a corresponding third terminal (2), a second signal generating means including a second sensor, a second reference source (15) and a second comparator (45) for generating a second task signal each time the patient performs satisfactorily a second physical task, and second enabling means (34) for connecting said second signal generating means with said counter when said stepping register is in its third operating state.

5. Apparatus as defined in claim 1, and further including second counter means (50) connected with said stepping register for counting the number of times said register is in a given one of its operating states, and means (50) for inhibiting the change of state of said register after a predetermined count has been registered in said second counter.

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