

Dec. 31, 1968

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ELECTRICAL CONTROL SYSTEM

3,419,732

Filed May 19, 1967

Sheet 1 of 3

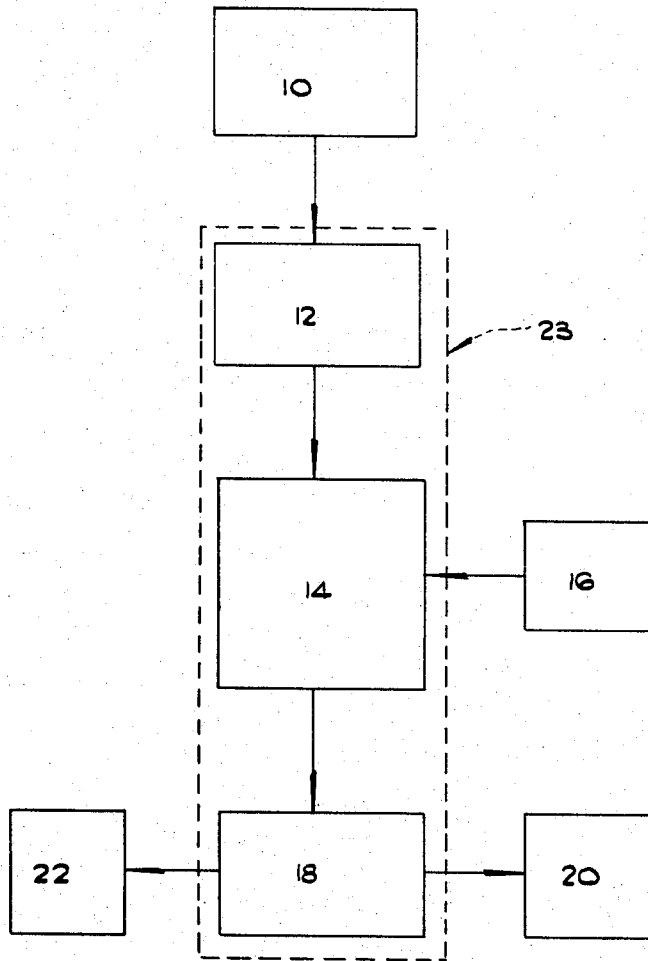


FIG. 1.

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Sheet 2 of 3

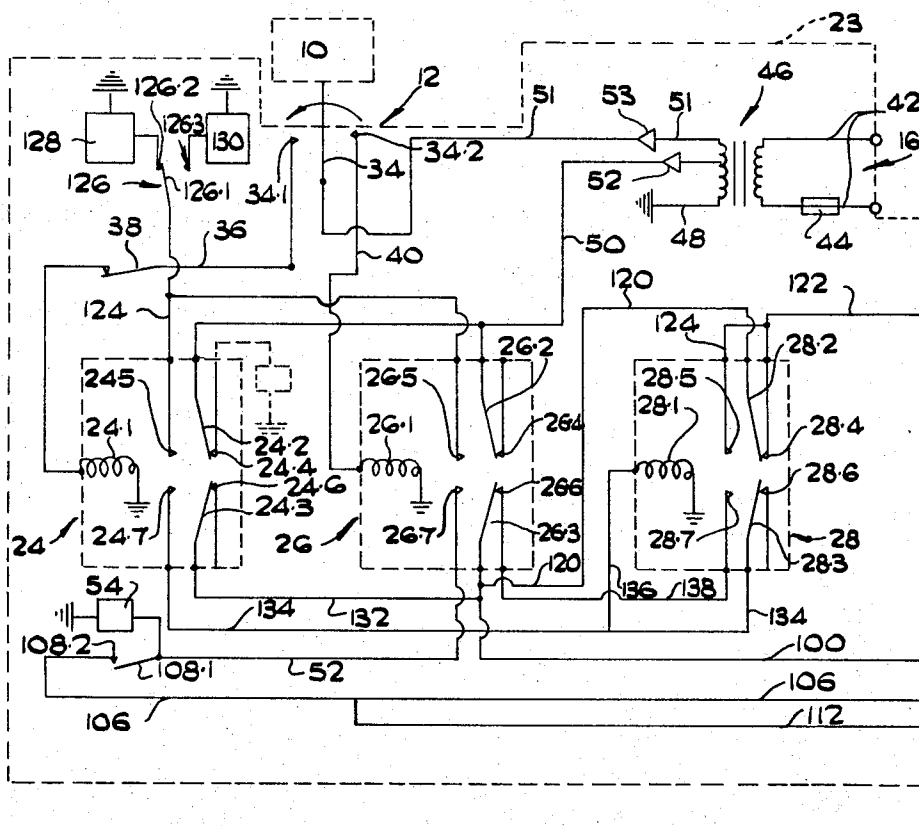


FIG. 2.

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Sheet 3 of 3

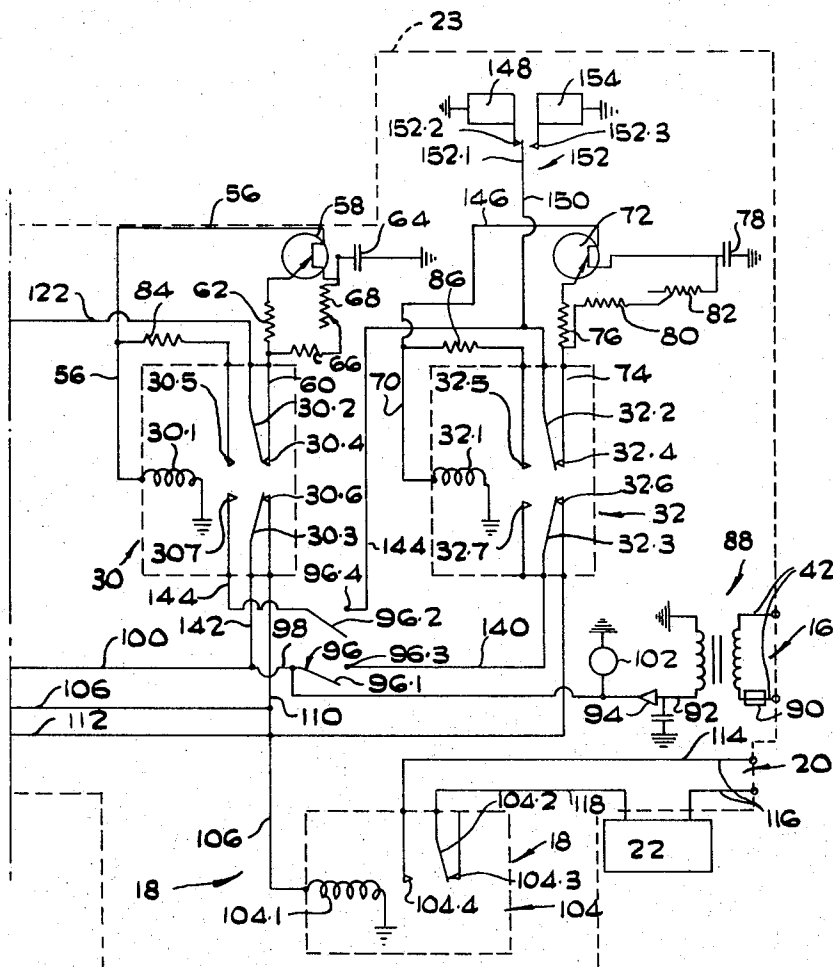


FIG. 3.

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1

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ELECTRICAL CONTROL SYSTEM

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Filed May 19, 1967, Ser. No. 643,795

Claims priority, application Republic of South Africa,

May 20, 1966, 66/2,932

23 Claims. (Cl. 307—116)

ABSTRACT OF THE DISCLOSURE

This invention relates to therapeutic apparatus for treating patients whose muscles or limbs have to be exercised. It includes exercising apparatus adapted for attachment to or operation by a patient for exercising his muscles or limbs, electrical switch means operatively connected to such exercising apparatus and to motivation apparatus. The electrical switch means is arranged to energize the motivation apparatus for as long as the exercising apparatus is operated correctly and in the required time intervals.

The present invention relates to electrical control systems.

More particularly, the invention relates to electrical control systems, which may be used with exercise apparatus for providing bodily or muscular exercises.

Many different methods are used to provide bodily or muscular exercises. In order to make such exercise interesting to a person or, in therapeutic applications, to a patient, some methods include exercise apparatus operable by the bodily or muscular movements of the persons, or patient, and mechanical transmission apparatus for transmitting such bodily or muscular movements to a further apparatus, called the motivation apparatus, for operation thereof. The purpose is to allow the motivation apparatus to be operated so long as the exercise apparatus is operated correctly, and in the required time intervals.

According to the invention, an electrical control system, includes a first switching means, a control circuit and second switching means, the first switching means being adapted to be operated due to a bodily or muscular movement executed on an exercise apparatus for energizing the control circuit thereby operating the second switching means for closing a supply circuit to a motivation apparatus for operation thereof.

The first switching means may be adapted to be operated intermittently for operating the control circuit.

The first switching means may be provided with two contacts which are connected to the control circuit, so that alternative contact is to be made with the contacts for operating the control circuit.

The electrical control system may include biasing means, operation of the first switching means being adapted to take place against the action of the biasing means. The biasing means may be adjustable for varying the degree of bias.

The first switching means may be provided with a lever switch arm, the leverage of which is adjustable.

The second switching means may include a motivation relay having at least one contact and a corresponding contact arm connected in series with one electrical power supply conductor leading to an electrically operable motivation apparatus, closure of the contact and corresponding contact arm being adapted to cause energization of the motivation apparatus.

The control circuit may include a time delay circuit.

2

The time delay circuit may include a time relay having one contact and a corresponding contact arm, which are normally closed, in series with a power supply conductor leading to the second switching means. The power supply conductor may lead to the coil of the motivation relay.

The time delay circuit may include a variable potentiometer and a capacitor in series, and a transistor connected in parallel with the potentiometer and also connected to the coil of the time relay, the time relay having a second contact and a corresponding second contact arm, which are normally closed, in series with a power supply conductor leading to the potentiometer and transistor.

The control circuit may include a first control relay, the coil of which is adapted to be energized on operation of the first switching means when moved to a first contact position; the control circuit further including an interruption relay, the coil of which is adapted to be energized on energization of the coil of the first control relay for interrupting a supply current to the time delay circuit.

The control circuit may include a second control relay, the coil of which is adapted to be energized on operation of the first switching means when moved to a second contact position, the second control relay having a contact and a corresponding contact arm, which are normally closed, in series with the power supply conductor leading from the first control relay to the coil of the interruption relay.

The control circuit may include a further time delay circuit in parallel with the first time delay circuit.

The further time delay circuit may include a further time relay having one contact and a corresponding contact arm, which are normally closed, in series with a further power supply conductor leading to the second switching means. The further power supply conductor may lead to the coil of the motivation relay.

The further time delay circuit may include a further variable potentiometer and a further capacitor in series, and a further transistor connected in parallel with the potentiometer, and also connected to the coil of the further time relay, the further time relay having a second contact and a corresponding second contact arm, which are normally closed, in series with a third contact and a corresponding third contact arm, which are normally open, on the time relay of the first mentioned time delay circuit, and in series with a power supply conductor leading to the further potentiometer and further transistor.

The electrical control system may include a counter circuit adapted to be energized on operation of the first switching means for operating a counter means for indicating the number of operations performed on the first switching means.

The electrical control system may include an indicating time range circuit for energizing an indicating means so as to indicate the time before the next operation of the first switching means is required so as to keep the motivation apparatus continually energized.

The electrical control system may include a warning circuit for energizing a warning indicating means when the further time delay circuit is being energized so as to give a warning that operation of the first switching means is required so as to keep the motivation apparatus continually energized.

The invention also extends to a combination of an exercise apparatus and an electrical control system as set out hereinbefore.

Further the invention also extends to a combination of an exercise apparatus, a motivation apparatus and an electrical control system as set out hereinbefore.

The exercise apparatus may be in the form of therapeutic apparatus or body building or training apparatus.

The therapeutic apparatus may be in the form of apparatus for providing exercise of the muscles of any limbs, the neck, the back or any other part of the body of a person, such as a functional arm splint apparatus.

The body building or training apparatus may be in the form of apparatus such as a stationary cycling arrangement, proximity device, weightlifting apparatus, contracting spring arrangement, extensible spring arrangement, punching bag arrangement or any pulling arrangement.

The motivation apparatus may be in the form of any electrical household appliance, such as a mixer, a vacuum cleaner, a polisher, a heating appliance, a fan appliance, or hair drying appliance.

The motivation apparatus also may be in the form of any electronic apparatus such as a radio, or electronic remote control apparatus.

Further the motivation may be in the form of any electrical tool, such as a lathe, drill, grinder, polishing machine, saw, a lapidary wheel or pottery wheel.

In particular where exercises are to be given, to children, the motivation may be in the form of electrical operable toys, such as electrical toy trains, electrical toy vehicles, electrical games or film or slide projectors.

Further according to the invention, a method of providing bodily or muscular exercises, includes the steps of providing exercising means on which a bodily or muscular movement can act, and of allowing such bodily or muscular movement acting on the exercising means to cause operation of an electrical control circuit for operating switching means for allowing a power supply to a motivation apparatus for operation thereof.

The motivation apparatus may also be in the form of an hydraulically operable apparatus, such as a compressed air drill or a gas soldering apparatus or welder, the second switching means being adapted to operate a valve for closing or opening an hydraulic supply to the hydraulically operable apparatus.

The invention will now be described by way of example, with reference to the following schematic drawings.

In the drawings:

FIGURE 1 shows a schematic block diagram of the combination of an exercise apparatus, a control system, and a motivation apparatus; and

FIGURES 2 and 3 show circuit diagrams of the control system.

Referring to FIGURE 1, reference numeral 10 indicates an exercise apparatus, the exercise apparatus being adapted to operate first switching means 12. The first switching means 12 are adapted to operate on operation thereof, a control circuit 14 which is energized from a power supply 16.

The operation of the control circuit 14 results in operation of second switching means 18. The operation of the second switching means 18 causes electrical current to flow from a power supply 20 to motivation apparatus 22 for operation thereof.

The first switching means 12, control circuit 14 and the second switching means 18 may be provided as an electrical control system unit 23, indicated in the block form. From this unit 23 the necessary conductors can lead for connection to power supplies and to the exercise apparatus 10 and the motivation 22.

The first switching means 12 may include a switch having two contacts and thereby requiring reciprocating movement of a contact arm for closing these two contacts. Alternatively, the switching means 12 may include a rotary switch so that a rotation of a contact arm is required for closing the various contacts.

As an example, it may be assumed that the exercise apparatus 10 is a pivotally mounted plate, which is moved against a bias spring by the foot of a patient so as to move the contact arm of a first switching means 12 to come alternately in contact with two contacts. Further it may

be assumed that the motivation apparatus 22 is an electrical drill operable by the patient for performing drilling operations in material such as wood.

In order to keep the electrical drill in operation, the patient will have to operate the pivotally mounted plate at a required rate.

Referring to FIGURE 2, the electrical circuit diagram of the electrical control system 23 is illustrated.

The control circuit 14 includes five relays, i.e. a first control relay 24, a second control relay 26, an interruption relay 28, a first time relay 30, and a further time relay 32 respectively. The various coils of the relays are indicated by reference numerals 24.1, 26.1, 28.1, 30.1 and 32.1. Each relay is provided with two contact arms, such as 24.2, 24.3, and two sets of contacts, such as 24.4 and 24.5, 24.6 and 24.7.

The first switching means 12 includes a lever switch arm 34, which is adapted to come into contact with contacts 34.1 and 34.2 depending on the movement given thereto by means of the exercise apparatus 10. The leverage of the switch arm 34 is adjustable and is adapted to act against bias means, such as a spring, against a frictional resistance, or against a pressure force.

Contact 34.1 is connected to the coil 24.1 via conductor 35 having in series therewith switch 38.

The other contact 34.2 is connected to the coil 26.1 via the conductor 40.

Power is supplied to the control circuit 14 from a power supply 16, which is in the form of a mains supply 42, having a fuse 44 in series with one of the conductors, the mains supply 42 leading to the primary of a transformer 46. From the secondary of the transformer 46 one conductor 48 is earthed, and the two conductors 50 and 51 leading therefrom are respectively provided with rectifiers 52 and 53. The conductor 51 may be for a 3 volt supply and the conductor 50 for a 5 volt supply. The conductor 50 leads to the contact arms 24.2 and 26.2 respectively. The conductor 51 leads to the switching arm 34.

The contact 26.7 is connected via conductor 52 to a counter 54, which is earthed.

The coil 30.1 is connected via conductor 56 to a uni-junction transistor 58. Also connected to the transistor 58 is contact 30.4 via conductor 60 having in series therewith resistance 62. The base of the transistor 58 is earthed, via a capacitor 64. A resistance 66 and variable potentiometer 68 bridge the transistor 58 across the conductor 60 to the base. The conductor 56 is connected to the contact 30.5 via a resistance 84. The time relay 30, potentiometer 68, transistor 58 and capacitor 64 form the first time delay circuit.

The coil 32.1 is connected via conductor 70 to a uni-junction transistor 72. The contact 32.4 is connected via conductor 74 and resistance 76 to the transistor 72. The transistor 72 is earthed via a capacitor 78. The base of the transistor 72 is bridged via a resistance 80 and a variable potentiometer 82. The conductor 70 is connected to the contact 32.5 via the resistance 86. The further time relay 32, further potentiometer 82, further transistor 72 and further capacitor 78 form the further time delay circuit.

The time required for charging the capacitors 64 or 78 so that discharge takes place via transistors 58, 72, respectively for energizing coils 30.1 and 32.1 respectively, will depend on the respective adjustment of potentiometers 68 and 82.

A further current supply from the current supply via mains 42 is provided, the mains being connected to a transformer 86 having in series with its primary a fuse 90, the secondary being earthed on one side and on the other side being connected to a conductor 92 including a rectifier 94.

The conductor 92 may be connected via switch 96 to contact arm 32.3. The conductor 92 is connected via conductor 98 to contact arm 30.3 and via conductor 100 to contact arm 26.3.

An earthed indicator light 102 is connected to the conductor 92 for indicating that current is flowing.

The second switching means 18 includes a relay 104. The relay 104 has a coil 104.1 and a contact arm 104.2 movable to contact with contacts 104.3 and 104.4 respectively.

The coil 104.1 may be connected via conductor 106 to conductor 52, conductor 106 by closing the switch 108, which is normally open. Conductor 106 is also connected via conductor 110 to a contact 30.6 and via conductor 112 to contact 32.6.

The power supply to the motivation apparatus 22 comes from a power supply 20 including two conductors 114 and 116 respectively. Conductor 116 is directly connected to the motivation apparatus 22. Conductor 114 is connected to the contact 104.4. The contact arm 104.2 is connected via conductor 118 to the motivation apparatus 22.

All of the contact arms of the various relays are shown in the position when the switching arm 34 of the first switching means 12 is in the central or inoperative position, as shown in the drawing.

The various earthed parts as indicated may be connected to the equally earthed secondary of the various transformers, if required. Alternatively, separate earth plates may be provided, one for each earthed secondary of the various transformers.

The various mains supplies, transformers and rectifiers may be replaced by battery current supplies.

The operation is as follows:

Initially when the various current supplies are switched on, current will flow from the transformer 88 via the conductor 92, the conductor 98, through the contact arm 30.3, contacts 30.6, conductor 110, conductor 106 to the coil 104.1, which is then energized. Thereby the contact arm 104.2 is moved into contact with the contact 104.4 resulting in current flow from the current supply 20 to the motivation apparatus 22. Accordingly, the motivation apparatus will be operated.

However, simultaneously current is supplied from the transformer 88 through the conductor 98, the conductor 100, conductor 120, contact arm 28.2, contact 28.4, conductor 122, contact arm 30.2, contact 30.4, conductor 60, resistance 66, potentiometer 68, to the capacitor 64. The capacitor 64 is thereby progressively charged, the speed of charging depending on the setting of the potentiometer 68. As soon as the capacitor 64 discharges, it discharges via the transistor 58 and through the emitter thereof, via the conductor 56 to energize the coil 30.1. On energization of the coil 30.1 contact arm 30.3 moves away from contact 30.6. Thereby the supply current from the transformer 88 to the coil 104.1 is interrupted resulting in movement of the contact arm 104.2 away from contact with the contact 104.4. Thereby the current supply to the motivation apparatus 22 is interrupted and the motivation apparatus comes to a standstill. Energization of coil 30.1 also causes the contact arm 30.2 to come into contact with the contact 30.5. Thereby the coil 30.1 is continually energized via the conductor 122. Accordingly the contact arm 30.3 will stay in contact with contact 30.7 so that the motivation apparatus 22 is kept de-energized.

Assuming now that the person or patient operates the exercise apparatus 10, by moving the switch arm 34 to come into contact with the contact 34.1, the following operation will take place:

Current will flow from the transformer 46 via conductor 51 through the switch arm 34, contact 34.1, conductor 36, switch 38, to energize the coil 24.1.

On energization of the coil 24.1, the contact arms 24.2 and 24.3 will move so as to come into contact with the contacts 24.5 and 24.7 respectively.

When the contact arm 24.2 comes into contact with the contact 24.5, current will flow from the transformer 46 via conductor 50, through contact arm 24.2, contact 24.5, conductor 124 to the switch 126 to energize the visual range signal 128. Thereby it is indicated when the next

movement of the switch arm 34 is required to keep the motivation apparatus 22 in operation. Alternatively, the contact arm 126.1 of the switch 126 may be moved to come into contact with the contact 126.3, for energization of an audible range signal 130 if required.

When contact arm 24.3 comes into contact with contact 24.7 current will flow from the transformer 88 via conductor 92, conductor 98, conductor 100, conductor 132 through the contact arm 24.3, contact 24.7, conductor 134 and conductor 136 to energize the coil 28.1. Energization of the coil 28.1 will cause the contact arms 28.2 and 28.3 to move into contact with the contacts 28.5 and 28.7 respectively.

While the contact arm 28.2 moves towards the contact 28.5 the energization of the coil 30.1 through the contact arm 30.2 is interrupted. Thereby the coil 30.1 is de-energized so that contact 30.2 moves back into contact with contact 30.4. Accordingly, the capacitor 64 will be charged again and in the meanwhile current will flow to the motivation apparatus 22 because the coil 104.1 is again energized.

The motivation apparatus 22 will then be energized for a certain time period while the capacitor 64 is being charged. The time which is to lapse before the first switching means 12 is to be operated again, is then indicated on the visual indicator 128 (or the audio indicator 130) where required.

The switch arm 34 is then to be moved to come into contact with the contact 34.2 before the capacitor 64 discharges. Thereby the coil 26.1 will be energized via conductor 40, contact 34.2, contact arm 34, and conductor 51 from the transformer 46.

Energization of the coil 26.1 will result in the movement of contact arms 26.2 and 26.3 to come into contact with the contacts 26.5 and 26.7 respectively.

When the contact arm 26.2 comes into contact with the contact 26.5 the visual indicator 128 (or the audio indicator 130) will be energized as before. Also the counter 54 will be energized via conductor 52, contact 26.7, contact arm 26.3 and conductor 100, so that the unit is counted and indicated.

In the meanwhile coil 28.1 will be kept energized via conductor 136, conductor 134, contact arm 28.3, contact 28.7, conductor 138, contact 26.5, contact arm 26.3, conductor 100, conductor 98, and conductor 92.

Movement of the switch arm 26.3 out of contact with the contact 26.6 will result that this current supply from the transformer 88 via conductor 100, and contact arm 26.3, contact 26.6 to the coil 28.1 is interrupted and therefore the coil 28.1 is de-energized. Also the current supply to the capacitor 64 is interrupted and while contact arm 28.2 moves from contact 28.5 to contact 28.4 the charge of the capacitor therefore leaks rapidly away. Accordingly, the motivation apparatus 22 is kept energized because contact arm 30.3 and contact 30.6 stay in contact. However, as soon as the contact arm 28.2 makes contact with the contact 28.4 again, the capacitor 64 will be charged again.

In order to keep the motivation apparatus energized, the switch arm 34 is then to be moved to come into contact with the contact 34.1 before the capacitor 64 discharges. This procedure is to be continued with, so long as energization of the motivation apparatus is required.

Where the exercises performed by the exercise apparatus 10 are such that a relatively long period (e.g. 60 seconds) is required between consecutive movements, the further time relay circuit may be included. This is done by closing switch arms 96.1 and 96.2 of switch 96 to come into contact with contacts 96.3 and 96.4 respectively. Thereby, if coil 30.1 is energized resulting in de-energization of coil 104.1 (via contact arm 30.3 and contact 30.6), coil 104.1 will be kept energized through conductor 140, contact arm 32.3, contact 32.6, and conductor 112.

When on energization of coil 30.1 the contact arm 30.3

comes into contact with contact 30.7, current will flow from the transformer 88, via conductor 92, conductor 98, conductor 142, contact arm 30.3, contact 30.7, conductor 144, switch arm 96.2, contact arm 32.2, contact 32.4 and via resistance 80 and potentiometer 82 to the capacitor 78. The capacitor 78 will then be charged and if it reaches a sufficient charge, it will discharge through the transistor 72, resulting in energization of the coil 32.1 via conductor 146 leading from the transistor 72. Thereby contact arms 32.2 and 32.3 will respectively come into contact with contacts 32.5 and 32.7. Accordingly, the coil 104.1 will be de-energized resulting in stoppage of the motivation apparatus 22.

For indicating to a person or patient that the motivation apparatus is about to stop, and that a next operation on the switching means 12 is necessary, a visual warning device 148 may be provided connected to the conductor 144 via conductor 150 and switching arrangement 152. Alternatively, the switch arm 152.1 of the switch 152 may be moved to come into contact with the contact 152.3 to connect an audible warning device 154 to the power supply. This visual warning device 148 (or audible warning device 154) will be energized as soon as coil 30.1 is energized. The person or patient will then know that the time has expired and that immediate further operation of the switching means 12 is required.

The further time delay circuit may be set (by variation of the setting of the potentiometer 82) to give say further 5 seconds till de-energization, of coil 104.1.

If only a lengthy muscle movement is required to act on the exercise apparatus 10 (e.g. where only the muscle of the forearm is to be contracted for a considerable period, say 5 minutes) then the switch 108 is closed and switch 38 is opened. The person or patient will then be required to move switch arm 34 to come into contact with contact 34.2. Thereby coil 26.1 is energized and contact arm 26.3 moves into contact with contact 26.7. Current is then supplied via conductor 100, contact arm 26.3, contact 26.7, conductor 52, switch arm 108.1, and conductor 106 to energize coil 104.1. Current is then supplied to the motivation apparatus 22. Energization of the motivation apparatus 22 will be continued so long as switch arm 34 is kept in contact with contact 34.2.

I claim:

1. An electrical control system which includes first switching means, a control circuit and second switching means, the first switching means being adapted to be operated due to a bodily or muscular movement executed on an exercise apparatus for energizing the control circuit thereby operating the second switching means for closing a supply conductor to a motivation apparatus for operation thereof.

2. An electrical control system as claimed in claim 1, in which the first switching means is adapted to be operated intermittently for operating the control circuit.

3. An electrical control system as claimed in claim 1, in which the first switching means is provided with two contacts which are connected to the control circuit, so that alternative contact is to be made with the contacts for operating the control circuit.

4. An electrical control system as claimed in claim 1, and which includes biasing means, operation of the first switching means being adapted to take place against the action of the biasing means.

5. An electrical control system as claimed in claim 4, in which the biasing means is adjustable for varying the degree of bias.

6. An electrical control system as claimed in claim 1, in which the first switching means is provided with a lever switch arm, the leverage of which is adjustable.

7. An electrical control system as claimed in claim 1, in which the second switching means includes a motivation relay having at least one contact and a corresponding contact arm connected in series with one electrical supply conductor leading to an electrically operable motivation

apparatus, closure of the contact and corresponding contact arm being adapted to cause energization of the motivation apparatus.

8. An electrical control system as claimed in claim 1, in which the control circuit includes a time delay circuit.

9. An electrical control system as claimed in claim 8, in which the time delay circuit includes a time relay having one contact and a corresponding contact arm, which are normally closed, in series with a power supply conductor leading to the second switching means.

10. An electrical control system as claimed in claim 9, in which the power supply conductor leads to the coil of the motivation relay.

11. An electrical control system as claimed in claim 9, in which the time delay circuit includes a variable potentiometer and a capacitor in series, and a transistor connected in parallel with the potentiometer and also connected to the coil of the time relay, the time relay having a second contact and a corresponding second contact arm, which are normally closed, in series with a power supply conductor leading to the potentiometer and transistor.

12. An electrical control system as claimed in claim 8, in which the control circuit includes a first control relay, the coil of which is adapted to be energized on operation of the first switching means when moved to a first contact position; the control circuit further including an interruption relay, the coil of which is adapted to be energized on energization of the coil of the first control relay for interrupting a supply current to the time delay circuit.

13. An electrical control system as claimed in claim 12, in which the control circuit includes a second control relay, the coil of which is adapted to be energized on operation of the first switching means when moved to a second contact position, the second control relay having a contact and a corresponding contact arm, which are normally closed, in series with the power supply conductor leading from the first control relay to the coil of the interruption relay.

14. An electrical control system as claimed in claim 8, in which the control circuit includes a further time delay circuit in parallel with the first time delay circuit.

15. An electrical control system as claimed in claim 14, in which the further time delay circuit includes a further time relay having one contact and a corresponding contact arm, which are normally closed, in series with a further power supply conductor leading to the second switching means.

16. An electrical control system as claimed in claim 15, in which the further power supply conductor leads to the coil of the motivation relay.

17. An electrical control system as claimed in claim 15, in which the further time delay circuit includes a further variable potentiometer and a further capacitor in series, and a further transistor connected in parallel with the potentiometer, and also connected to the coil of the further time relay, the further time relay having a second contact and a corresponding second contact arm, which are normally closed, in series with a third contact and a corresponding third contact arm, which are normally open, on the time relay of the first mentioned time delay circuit, and in series with a power supply conductor leading to the further potentiometer and further transistor.

18. An electrical control system as claimed in claim 1, which includes a counter circuit adapted to be energized on operation of the first switching means for operating a counting means for indicating the number of operations performed on the first switching means.

19. An electrical control system as claimed in claim 1, including an indicating time range circuit for energizing an indicating means so as to indicate the time before the next operation of the first switching means is required so as to keep the motivation apparatus continually energized.

20. An electrical control system as claimed in claim 15, including a warning circuit for energizing a warning indi-

cating means when the further time delay circuit is being energized so as to give a warning that operation of the first switching means is required so as to keep the motivation apparatus continually energized.

21. A combination of an exercise apparatus and an electrical control system as claimed in claim 1. 5

22. A combination of an exercise apparatus, a motivation apparatus, and an electrical control system as claimed in claim 1.

23. A combination as claimed in claim 22, in which the exercise apparatus is in the form of therapeutic apparatus or body building or training apparatus. 10

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U.S. Cl. X.R.

272—57; 307—141