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ELECTROMAGNETIC COMBINATION SWITCH OPERATING MEANS

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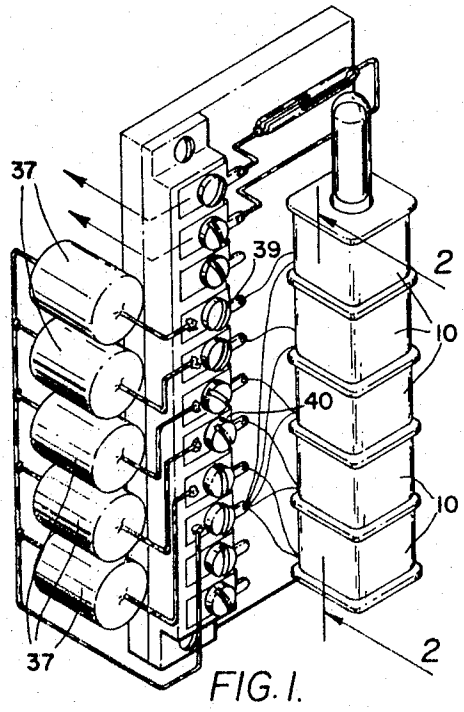


FIG. 1.

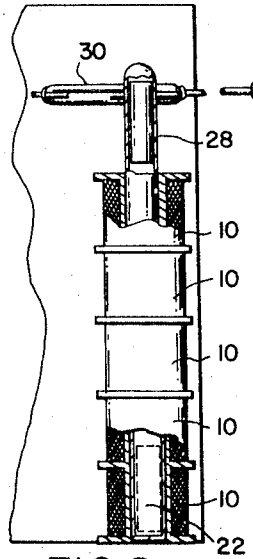


FIG. 2.

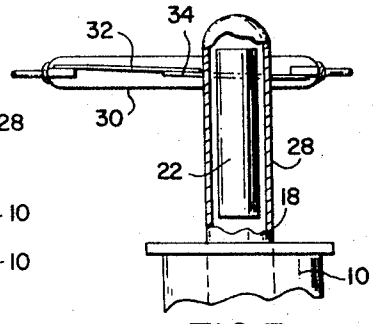


FIG. 3.

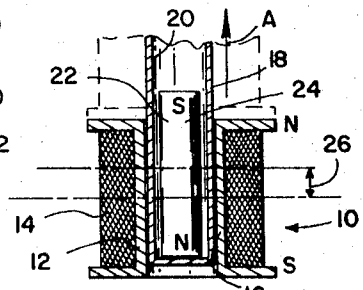


FIG. 4.

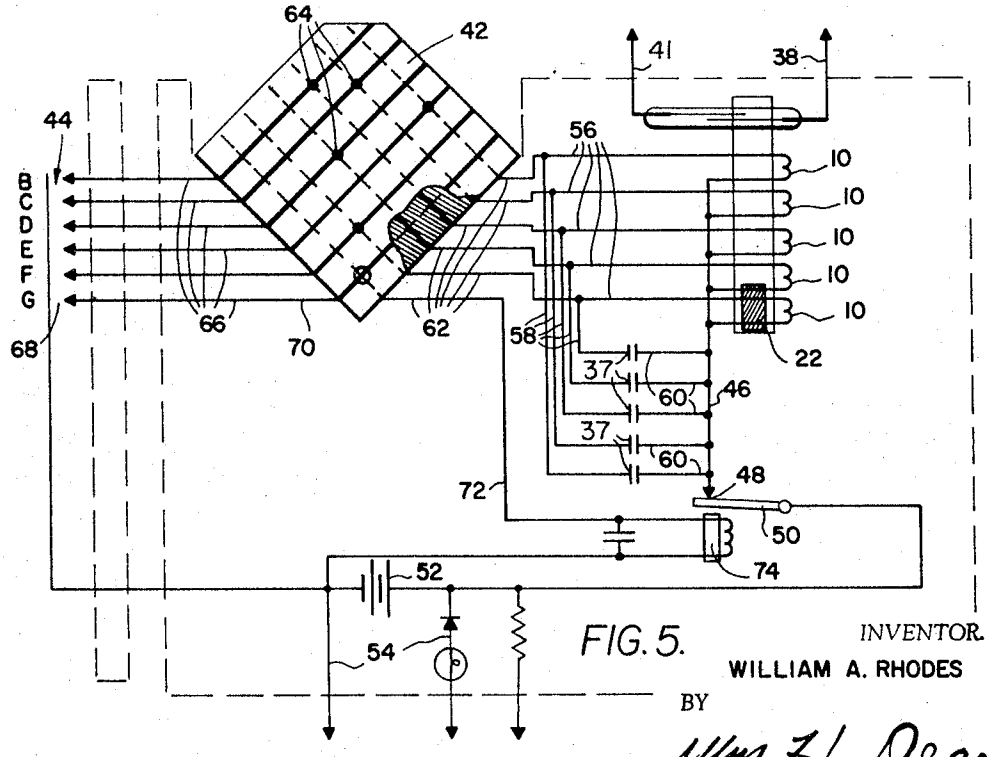


FIG. 5.

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ELECTROMAGNETIC COMBINATION SWITCH OPERATING MEANS

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ABSTRACT OF THE DISCLOSURE

An electromagnetic combination switch operating means comprising a plurality of solenoid elements progressively energizeable through a plurality of manually coded switches, and electrical time delay means in circuit with the switches and the solenoid means to permit sequential operation of the switches to provide sequential movement of a magnetically responsive member through said solenoids and another switch operable by the magnetically responsive member after it has traversed the said solenoids.

This invention relates to an electromagnetic combination switch operating means, and more particularly, to an electromagnetic combination switch operating means which is particularly adapted for use in operating locks or other devices by means of the actuation of a plurality of switches in certain continuity relative to each other.

It is known that combination locks, and other devices are operable by actuating certain devices in numerical order or in certain successive continuity in order to attain an ultimate operation. A need for an electrically operable combination device has been recognized, and particularly for such a device, wherein a plurality of switches must be operated in certain successive sequence in order to attain the ultimate operation of another switch, which either actuates a lock or the device.

Accordingly, it is an object of the present invention to provide a novel electromagnetic combination switch operating means of very simple and durable construction.

Another object of the invention is to provide an electromagnetic combination switch operating means, wherein a plurality of manually operable switches may be successively operated in continuity relative to each other to energize a plurality of respective adjacent electromagnetic means so as to move a magnetically responsive member to a position to actuate another switch adapted to control a lock, or the like, and wherein each manually operable switch is coupled to a time delay device which permits a slight delay to elapse between the actuation of successive manually operable switches, and the respective electromagnetic means operable thereby.

Another object of the invention is to provide an electromagnetic combination switch operating means employing a plurality of manually operable switches connected to respective electromagnetic means, and to capacitors; the electromagnetic means being in adjacent relationship to each other, and adapted to influence the progressive movement of a magnetically responsive member from the electromagnetic field of one of the electromagnetic means to the next thereof, such that the magnetically responsive means may be actuated into a position to operate another switch; said capacitors being capable of maintaining energization of each respective electromagnetic means for a short period of time after the respective manual switch has been operated to thereby allow sufficient time for the next successive manually operable switch to be actuated, and to thereby permit the operation in sequence and in continuity of a plurality of the manually operable switches to progressively move said magnetically responsive member from one field of each

electromagnetic means to the next, and progressively to dispose said magnetically responsive member into a position to operate another switch.

Another object of the invention is to provide a novel electromagnetic combination switch operating means, which is particularly adapted for operating door locks or any other device which requires the use of a distinctive combination for operating it.

Another object of the invention is to provide a novel electromagnetic combination switch operating means, wherein a plurality of manually operable switches include a cancellation switch, some of the switches being connected to electromagnetic means for sequentially moving a magnetically responsive member to actuate another switch, said cancellation switch being coupled to a relay for disconnecting energy to the electromagnetic means in the event the cancellation switch is inadvertently operated by someone inexperienced with the successive operation of the manual switches in proper continuity.

Further objects and advantages of the present invention may be apparent from the following specification, appended claims, and accompanying drawings, in which:

FIG. 1 is a perspective view of electromechanical portions of the electromagnetic combination switch operating means of the present invention;

FIG. 2 is a fragmentary sectional view taken from the line 2—2 of FIG. 1, showing parts and portions of the mechanism in elevation;

FIG. 3 is an enlarged fragmentary view similar to the upper portion of FIG. 2;

FIG. 4 is an enlarged fragmentary sectional view similar to the lower portion of FIG. 2; and

FIG. 5 is a diagrammatic view illustrating the electrical circuitry of the present invention in relation to some of the electro-mechanical parts thereof.

As shown in FIGS. 1 to 4 of the drawings, the invention comprises a plurality of electromagnetic means **10**. These individual electromagnetic means **10** are as shown in FIG. 4 of the drawings, they each comprise a hollow cylindrical spool **12** having a winding **14** thereon, and the spool **12** is provided with a bore **16**, thus, each electromagnetic means **10** is a solenoid. As shown in FIG. 1 of the drawings, five of these hollow cylindrical solenoids are arranged in adjacent relationship to each other, and a sleeve **18** of hollow cylindrical construction is disposed internally of the respective bores **16** of the individual electromagnetic means **10**. The hollow cylindrical tube **18** is provided with a bore **20** in which a magnetically responsive means **22** is positioned. This magnetically responsive means **22** is preferably a permanent magnet having one pole portion **24** disposed beyond the respective electromagnetic means **10**, such that the center of mass of the magnetically responsive means **22** is displaced from the center of the electromagnetic field of the electromagnetic means **10**, this being indicated by the double ended arrow **26** illustrating the relative displacement of the center of mass of the magnetically responsive member **22**, such that it will always be energized in an upward direction within the tube **18**. The electromagnetic means **10** being superimposed in adjacent relationship to each other, the sleeve **18** is preferably a non-magnetic material and an upper portion **28** of the sleeve **18** extends above an uppermost electromagnetic means **10**, as shown best in FIGS. 1, 2 and 3 of the drawings. Adjacent to the upwardly extending portion **28** of the sleeve **18** is a reed switch **30** having a pair of magnetically responsive contacts **32** and **34** therein. There being disposed such that when the permanent magnet-type magnetically responsive member **22** is moved adjacent to the switch **30**, that the contact members **32** and **34** will be forced together, and to make contact between electrical conductors **38** and **41**, as shown in FIG. 5. These conductors **38** and **41** may be

coupled to an electrically operable lock or any other means, as desired.

It will be understood that the polarity of each electromagnetic means is such, as to repel the magnetically responsive member **22** in an upward direction, as indicated by an arrow A in FIG. 4 of the drawings. This is particularly effective with respect to the polarity of the magnetically responsive member **22**, which as hereinbefore described, is a permanent magnet.

Coupled to the electromagnetic means **10** are respective capacitors **37** which are connected to connections **39** on a terminal block **40**, and leads from the electromagnetic means **10** are also coupled to the connections **39**, as will be hereinafter described.

The capacitors **37** are also coupled to a wafer board **42** to which a group of manual switches **44** are also coupled.

As shown in FIG. 5 of the drawings, each electromagnetic means **10** is coupled to a power source by means of a conductor **46**, connected to a normally closed relay switch **48** having a conductor **50** coupled thereto, and in circuit with a D.C. power source **52** or an A.C. power source **54**, as desired.

The electromagnetic means **10** are provided with respective electrical conductors or leads **56**. Connected to the connections **39** on the terminal block **40**, and the capacitors **37** are also connected by means of respective conductors **58** to the connections **39** on the terminal block **40**. Additionally, the capacitors **37** are provided with respective conductors **60** connected to the power source conductor **46**, hereinbefore described.

Coupled to the conductors **56** and **58** are respective conductors **62**, which are connected to the wafer board **42**. This wafer board **42** is provided with conventional opposed printed circuitry arranged in an intersecting grid pattern, such that couplings **64** extend through the wafer board and make connections with printed circuitry on opposite sides of the wafer board **42** to thereby selectively connect the conductors **62** with manual switch conductors **66** which are connected to manual switches of the manual switch group **44**. These manual switches may be in the form of push buttons, and may be aligned, as for example, adjacent the front door of a dwelling so that the switches may be pushed in sequence ultimately to operate the switch **30**, and to actuate a lock on the door.

It will be seen that the couplings **64** may be varied to provide a different sequential operation of the manual switches in the group **44** so as progressively to energize the electromagnetic means **10** from the lowermost one thereof in continuity to the uppermost one thereof in order to elevate the magnetically responsive member from the position, shown in FIG. 4, to the position, shown in FIG. 2, and to thereby magnetically operate the switch **30**, which as hereinbefore described, may be connected to a door lock or any other device, as desired.

The group of manually operable switches **44** comprises a cancellation switch **68** connected to electrical conductors **70** and **72**. The electrical conductor **72** being disposed to operate a relay **74** for opening the normally closed switch **48** and de-energizing all of the electromagnetic means **10**, as will be hereinafter described.

In operation, the manually operable switches of the group **44** may be pressed in proper sequence, in accordance with a known combination for the purpose of progressively elevating the magentically responsive member **22** from the position, shown in FIG. 4, to the position, shown in FIG. 2, for actuating the switch **30**, as hereinbefore described.

It will be understood, that as the individual switches of the group **44** may be closed, a short time may elapse between the actuation of one switch and the next one in sequence. During this time, the capacitors **37** are respectively energized, and retain sufficient energy for momentarily holding the respective electromagnetic means **10** energized, and for thus holding the magnetically responsive member **22** in a certain elevated position. For example, when the switch of the group **44** in connection with the lower most electromagnetic means **10** is energized, the magnetic responsive member **22** is elevated to a position thereabove by magnetic repulsion, and the respective capacitor **37** maintains the respective electromagnetic means energized for a short period of time sufficient for the operator to press the next switch of the group **44** for energizing the next superimposed electromagnetic means **10**, and for repulsively propeliing the magnetically responsive member **22** to the next elevated position.

As shown in the diagrammatic view, FIG. 5, the manually operable switches of the group **44** are designated B, C, D, E, F and G, the switch G being the cancellation switch **68**. In accordance with the invention, and the operating sequence disclosed, manual switch F will be operated to energize the lowermost electromagnetic means **10**. The switch D may then be operated, followed by the switch B and next the switch E. Thus, the magnetically responsive member **22** may be elevated into proximity of the switch **34** for operating it.

It will be understood that the wafer board **42** may be arranged with any desired combination, such that the switches B, C, D, E and F may be operated in any sequential continuity, as desired, so that various and numerous combinations may be provided.

In the event the switch G is operated, all of the previously energized electromagnetic means **10** will be de-energized, and the magnetically responsive member **22** will drop to its lowermost position. The switch G may be connected in any manner, as desired, on the board **42**, and thus a person not familiar with the combination may inadvertently cancel the operation of the switch, whenever he operates the cancellation switch **68** or presses the button G.

It will also be understood that if a person hesitates a substantial period of time between the actuation of any of the switches **44**, that the capacitors **37** in their respective relation will not sustain energization of the respective electromagnetic means **10**, and the magnetically responsive member **22** will drop to the lowermost position.

It will be understood by those skilled in the art that while the magnetically responsive member **22** operates in response to gravity, that a low rate coil spring may be used to return the magnetically responsive member **22** to one end of the row of adjacent magnetically responsive means **10**, and in such instance, the magnetically responsive means **10** need not be superimposed.

It will be appreciated, however, that the embodiment of the invention shown in the drawings is preferred, and that the use of return springs in solenoid devices is well known, and within the range of equivalence of the present invention.

It will be obvious to those skilled in the art that various modifications of the present invention may be resorted to in a manner limited only by a just interpretation of the following claims.

I claim:

1. In an electromagnetic combination switch operating means, the combination of: a plurality of electromagnetic means disposed in a row having first and second ends, said electromagnetic means having their poles aligned with each other; a magnetically responsive member disposed to move progressively from electromagnetic means to an adjacent electromagnetic means in response to energization of the fields of said electromagnetic means, when energized progressively in adjacent successive relationship to each other; a first switch in position to be operable by said magnetically responsive member, when moved in one direction to said first end of said row; and a plurality of second switches disposed in circuits with respective ones of said plurality of electromagnetic means; second means in circuit with each respective second switch, and respective electromagnetic means, said second means disposed to maintain the respective electromagnetic means

energized for a short period of time, after operation of one of the respective second switches has happened and before another of said second switches is operated.

2. In an electromagnetic combination switch operating means, the combination of: a plurality of superimposed electromagnetic means disposed in a row, having first and second ends, said electromagnetic means having their poles aligned in a substantially vertical disposition; a magnetically and gravity responsive member disposed to move progressively vertically upward in response to the energization of the fields of said electromagnetic means, when energized progressively in adjacent successive relation to each other; a first switch in position to be operable by said magnetically responsive member, when moved in one direction to said first end of said row; a plurality of second switches disposed in circuit with respective ones of said plurality of electromagnetic means; and second means in circuit with each respective second switch and respective electromagnetic means, said second respective electromagnetic means energized for a short period of time after operation of the respective second switch has happened and before another of said second switches is operated.

3. The invention, as defined in claim 1, wherein: said electromagnetic means is each a hollow cylindrical solenoid structure, and said magnetically responsive member is disposed internally of said hollow electromagnetic means.

4. The invention, as defined in claim 2, wherein: each of said electromagnetic means is a hollow cylindrical solenoid, and said magnetically responsive member is disposed internally of said hollow cylindrical solenoids, and adapted to move axially therein.

5. The invention, as defined in claim 1, wherein: each of said second means is a capacitor.

6. The invention, as defined in claim 2, wherein: each electromagnetic means is a hollow cylindrical member, and said magnetically responsive member is mounted to move centrally therein, and each of said second means is a capacitor.

7. The invention, as defined in claim 1, wherein: an electromagnetic cancellation switch is disposed in circuit with said second switches, and wherein a third switch is disposed to energize said electromagnetic cancellation switch for deenergizing all of said electromagnetic means.

8. The invention, as defined in claim 6, wherein: said magnetically responsive member is a permanent magnet, and wherein said first switch is magnetically operable within the field of said magnetically responsive member, when moved into close proximity to said first switch.

9. The invention, as defined in claim 8, wherein: a guide is disposed above said electromagnetic means to guide said magnetically responsive member into close proximity to said first switch.

10. The invention, as defined in claim 1, wherein: stop means is disposed at said second end of said row of said electromagnetic means, said magnetically responsive member having a center of mass normally held beyond a center of a magnetic field of one of said electromagnetic means by said stop means to insure progressive electromagnetic propulsion of said magnetically responsive member from said second end of said row to said first end of said row of electromagnetic means.

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U.S. Cl. X.R.

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