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[54] **PROGRAMMED TIMING SYSTEM**
11 Claims, 6 Drawing Figs.

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200/38, 340/166, 340/309.1

[51] Int. CL..... **G04c 23/00,**
G04c 23/14

[50] Field of Search..... **340/309.4,**
309.5, 309.1, 286, 166; 200/38, 38 B, 38 C, 38 D;
307/141, 141.4

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ABSTRACT: A clock mechanism drives day, hour and minute stepping switches which provide energization as time progresses of output circuits for their respective units of time. Matrices of terminals for days, hours and minutes respectively are energized from the output circuits. Control circuits are selectively programmed by energization through gates having input wires detachably connected to selected terminals of the several matrices.

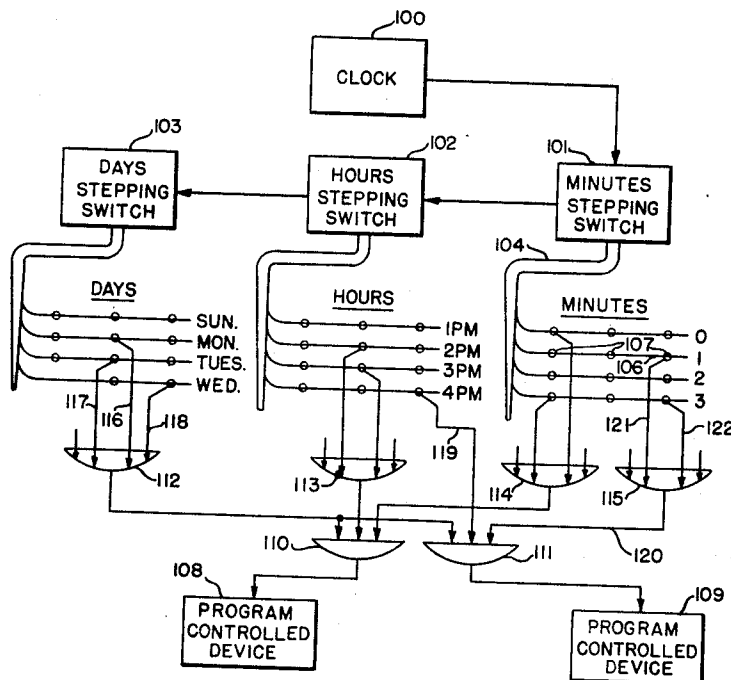


FIG. 1

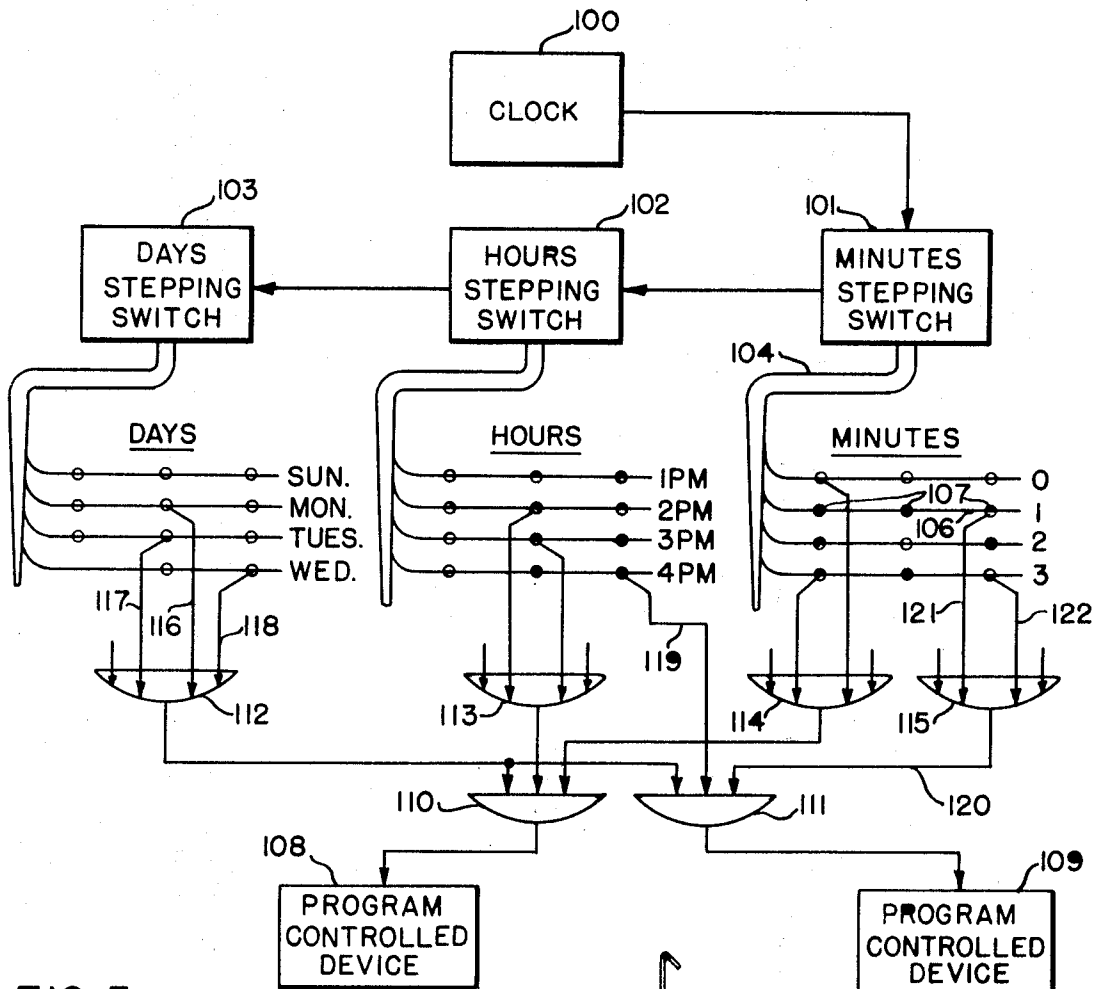


FIG. 5

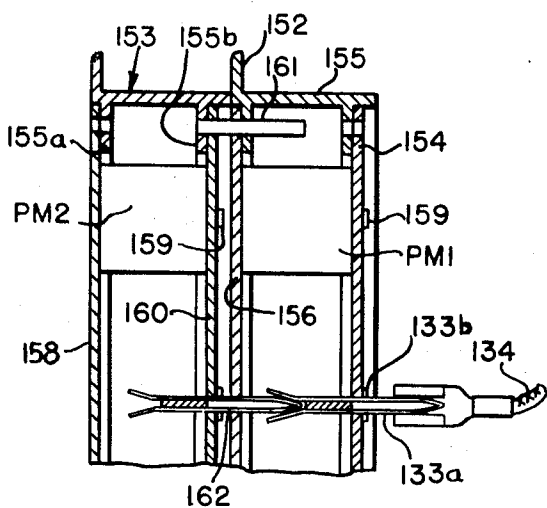
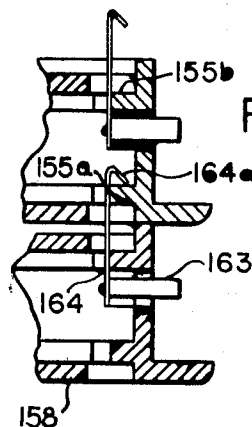


FIG. 6

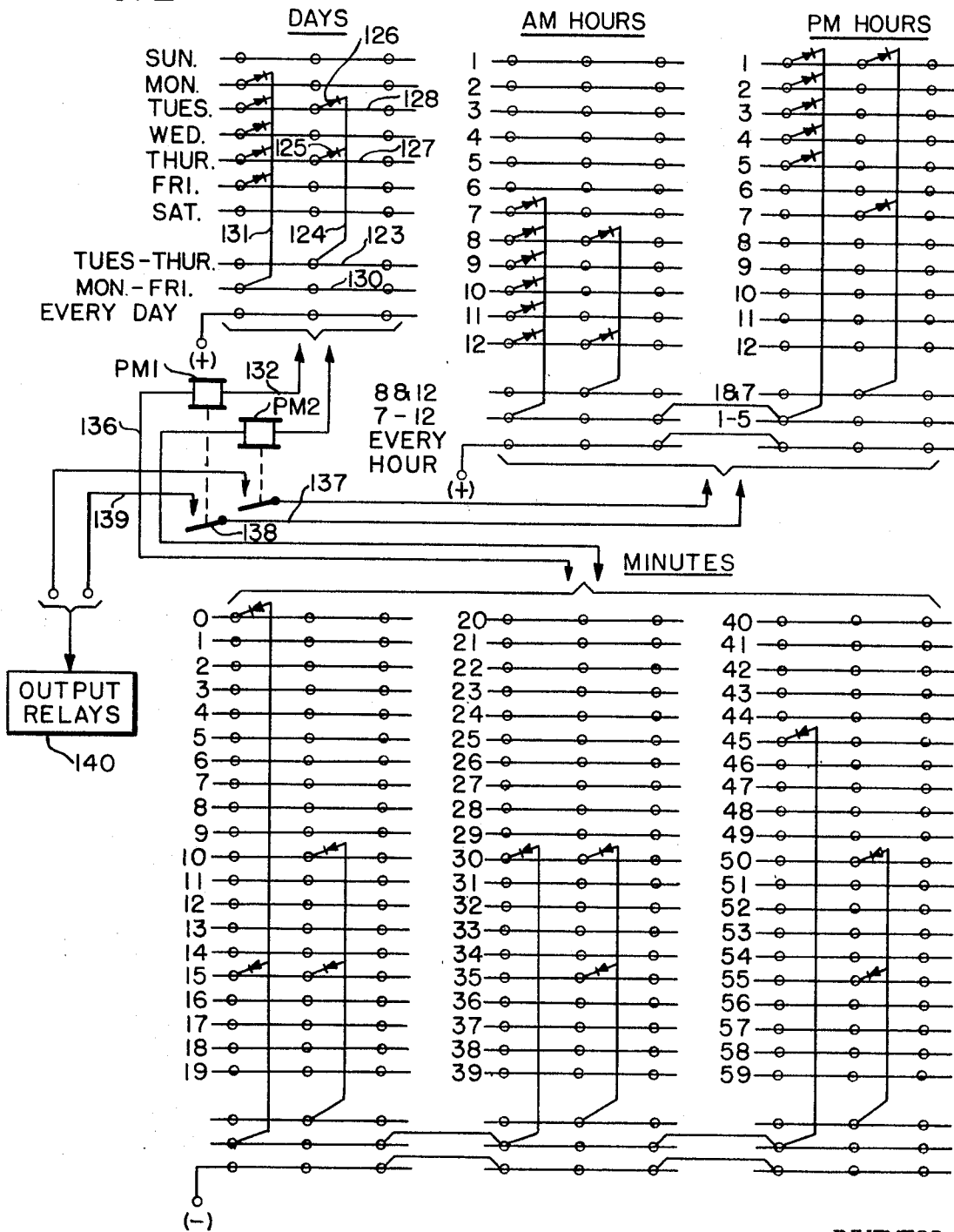


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FIG. 2



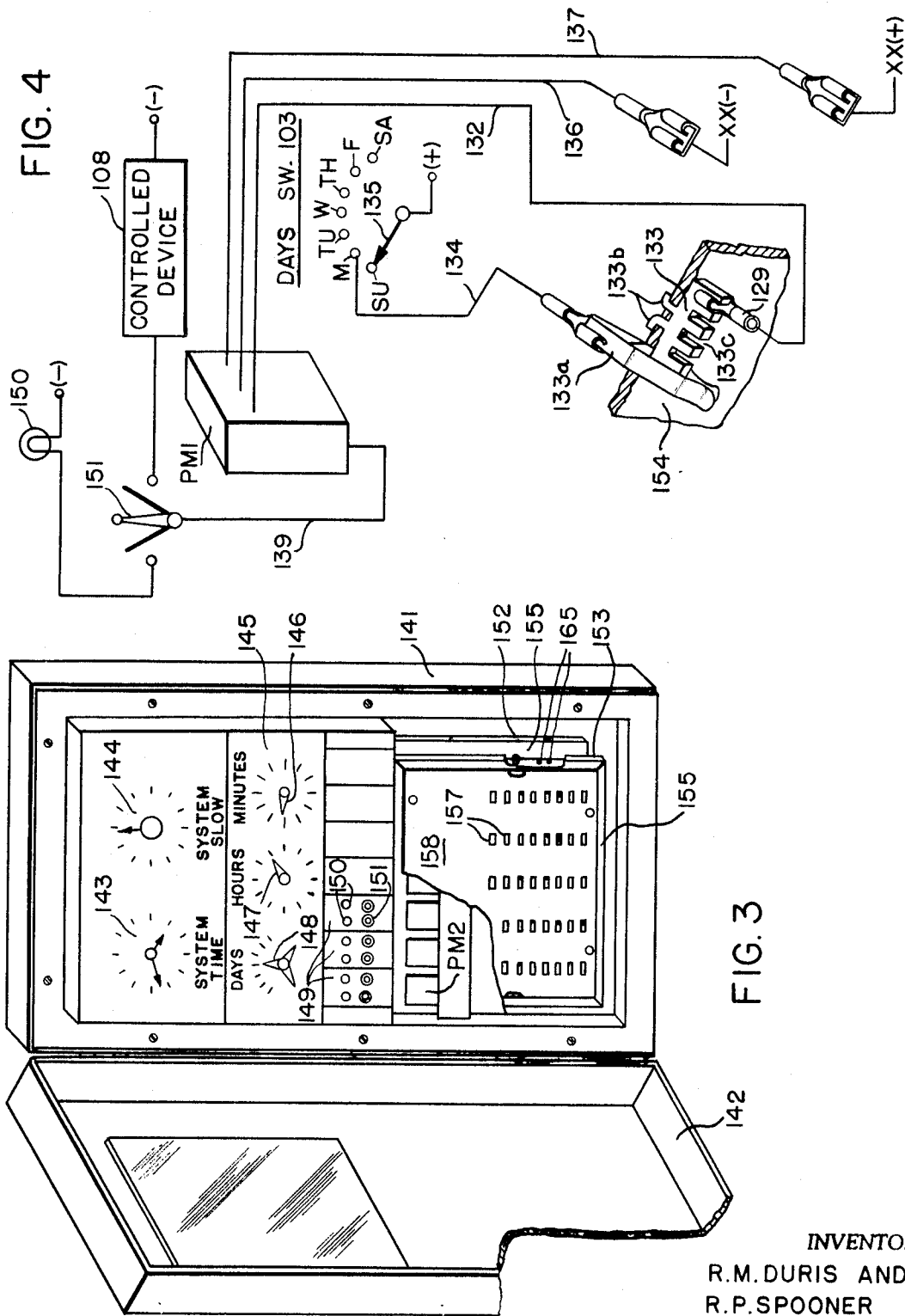
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PROGRAMMED TIMING SYSTEM

While the invention is subject to a wide range of applications, it is especially suited for a programmed timing system for selective energization of a plurality of control circuits, and will be particularly described in that connection.

Programmed timing systems are used for various applications, such, for example, as for the ringing of bells in a school or other public buildings, the control of electric locks, lights and the like. One of the most common systems used in practice has a drum rotated by a clock mechanism, the drum having time designated positions at which detachable cams or other devices can be positioned for actuation of contacts in respective output circuits when the drum is rotated to positions in correspondence with times that have been programmed for the several circuits. It requires considerable skill, and sometimes the use of hand tools, for an operator to set up and change programs in these systems.

An object of the present invention is to provide an improved programmed timing system for selectively energizing a plurality of control circuits wherein energization of the control circuits is enabled by gates having their input circuits energized according to a predetermined program as time progresses.

Another object of the present invention is to provide an improved programmed timing system for selectively energizing a plurality of control circuits wherein programs for the control circuits can be remotely designated and then detachably connected to time controlled energizing circuits as one or more detachable modular units.

SUMMARY OF INVENTION

A programmed timing system is provided for selectively energizing a plurality of control circuits comprising timing means driving day, hour and minute stepping switches which have output circuits successively energized as time progresses. The system has means including matrices of wire terminals energized by the output circuits of the stepping switches for units of days, hours and minutes respectively sensing time coincidence with a plurality of different selected programs for selectively energizing the control circuits. The matrices have a plurality of gates for governing energization of the several control circuits. Each of the gates has a plurality of input wires detachably connected to selected ones of the wire terminals of the several matrices.

According to one form of the present invention, a programmed timing system for selectively energizing a plurality of control circuits comprises in a cabinet timing means driving day, hour and minute stepping switches which have output circuits successively energized as time progresses. A first matrix module comprises a panel supporting connector terminals in rows and columns connected to the several output circuits of the stepping switches and adapted for quickly detachable connection with terminals of a second matrix module. The second matrix module comprises a panel laterally disposed relative to the panel of the first matrix module having terminals plug coupled to the terminals of the first matrix module. The second matrix module has a plurality of gates for delivering outputs to the several control circuits, each of the gates having a plurality of input wires detachably connected to selected connection terminals of the second matrix module for programming selected times for energization of the output circuits. By this arrangement, programs for the control circuits can be designated in the second matrix module before being plug coupled to the terminals of the first matrix module.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings, while its scope will be pointed out in the appending claims.

FIG. 1 illustrates schematically and partly by block diagram a programmed timing system for the selective energization of a plurality of control circuits according to a preferred embodiment of the present invention;

FIG. 2 illustrates schematically detail circuits that can be provided for certain elements of the system as illustrated in FIG. 1;

FIG. 3 is a perspective view of a cabinet containing the programmed timing system according to one embodiment of the present invention;

FIG. 4 is an enlarged view in perspective of a typical wire terminal together with a typical relay and circuit organization;

FIG. 5 is an enlarged partial sectional elevation of first and second modules of FIG. 3; and

FIG. 6 is another enlarged partial sectional elevation of first and second modules of FIG. 3.

With reference to FIG. 1, a simplified typical embodiment of the present invention is illustrated wherein a programmed timing system is provided for selectively energizing a plurality of control circuits. Timing means in the form of a clock 100 is provided for operating in turn a minutes stepping switch 101, an hours stepping switch 102 and a days stepping switch 103. These stepping switches have output circuits for their respective units. For example, the minute stepping switch 101 has an output circuit for each of the 60 minutes, these output circuits being energized successively as time progresses. As an alternative structure, the minute stepping switch 101 may be a self-contained synchronous motor driven minutes scanner, rather than being driven from the separate clock 100.

Matrices of wire terminals are provided for the several stepping switches. The output circuits of the minutes stepping switch 101, for example, are connected to respective terminals 106 through a wire cable 104. The typical wire terminal 106 has energy applied thereto by an output circuit of the minutes stepping switch 101 when that stepping switch is actuated by the clock 100 to its one minute position. The wire terminal 106 is adapted at points 107 for the attachment of a detachable wire connector for the programming of a selected time for energization of program controlled devices such as devices 108 and 109.

Energization of control circuits for devices such as 108 and 109 is enabled by gates connecting the output circuits for devices 108 and 109 to selected terminals 106 of the matrices governed by the minutes, hours and days stepping switches 101, 102 and 103 respectively. There is an AND gate provided for each of the control circuits to be programmed. Thus the AND gate 110 is provided to enable the control circuit for energization of program controlled device 108, and similarly the AND gate 111 is provided for enabling the control circuit for energization of the program controlled device 109.

Each of the AND gates 110 and 111 has inputs from the several matrices of wire terminals for minutes, hours and days. These inputs can be wires having detachable connectors connected to selected wire terminals 106 of the several matrices if the output circuits to be programmed are to operate at just a single time during a week. If the output circuits are to be programmed to operate at different times during a week, certain of the input wires to the AND gates are connected to the terminals 106 of the matrices through OR gates such as the gates 112, 113, 114 and 115. By having a first input to the AND gates 110 and 111 connected to the terminals 106 of the days matrix associated with the days stepping switch 103 through the OR gate 112, it is illustrated that the devices 108 and 109 can be energized by the enabling of gates 110 and 111 for the days, Monday, Tuesday and Wednesday because of wires 116, 117 and 118 being detachably connected to terminals 106 for these respective days. A second input to the AND gate 111 is illustrated as being applied by direct wire connection of wire 119 to a wire terminal of the hours matrix for the hour 4 p.m. A third input wire 120 for the AND gate 111 is energized through OR gate 115 by wires detachably connected to terminals 106 of the minutes matrix which is energized by the minutes stepping switch 101. This OR gate is illustrated as being enabled on minute No. 1 by wire 121 and minute No. 3 by wire 122. Therefore with the terminals selected to program the energization of device 109 as has been described, it will be readily apparent that the gate 111 is enabled for energization

of this control circuit on days, Monday, Tuesday and Wednesday during minutes 1 and 3 after 4 p.m. These times are selected for the purpose of illustration, and it should be readily apparent from the organization as it has been described, how control circuits can be programmed for any desired time by the selective connection of the detachable connectors to the wire terminals 106 of the respective matrices for the times desired to energize a control circuit.

With reference to FIG. 2, the OR gates described in FIG. 1 can take a form wherein auxiliary wire terminals are provided for the respective OR gates, and these auxiliary terminals are coupled by quickly detachable connections to terminals of the associated matrices for days, hours or minutes. More specifically, i.e., the auxiliary terminal 123 receives its energy through a jumper wire 124 that is connected through diodes 125 and 126 to terminals 127 and 128 respectively. This connection is preferably made by quickly detachable connectors such as the connector 129 shown in FIG. 4. The wire jumper 124 therefore provides by its connection that the auxiliary terminal 123 receives energy on Tuesdays and Thursdays. Thus connection is made in the programming of the AND circuits for control circuits that are to be energized on these days by detachably connecting inputs of these AND circuits to the Tuesday-Thursday auxiliary terminal 123. The terminal 123 in combination with jumper connection 124 provides an OR circuit comparable to the OR circuits 112, 113, 114 and 115 heretofore considered with reference to FIG. 1. In a similar manner, other auxiliary terminals can be programmed for other days such as the auxiliary terminal 130 which is programmed to be energized by the days matrix during the days Monday through Friday as selected by jumper 131. Similarly, auxiliary terminals are selectively energized for the matrices for hours and minutes as required according to desired programs.

With reference to FIGS. 2 and 4, a preferred embodiment of AND circuits corresponding to the AND circuits 110 and 111 of FIG. 1 is illustrated wherein the AND circuits are in the form of relays PM1 and PM2. Two of the input wires to each of the relay AND gates are connected to the relay winding and the third input wire is connected to a contact of the relay. More specifically, the relay PM1 has one side of its winding connected via wire 132 to a selected terminal in the days matrix. With reference to FIG. 4, this connection is made through the quickly detachable connector 129 to a days wire terminal 133, which in turn is connected by wire 134 to a position M for Monday in the days stepping switch 103. Energy is applied on Mondays to this terminal through the movable contact finger 135 which is connected to the positive terminal of a suitable source of direct current.

With reference to FIG. 2, the other side of the winding of the relay PM1 is connected by wire 136 to a selected minutes matrix terminal. The selected minutes terminal is in turn connected to an output circuit of the minutes stepping switch 101 the same as has been described in detail for the connection of the other side of the winding to a days stepping switch output, except that the output circuits of the minutes stepping switch 101 are energized with negative polarity. Such energization provides for the energization of the winding of the relay PM1 to be dependent upon the closure of both the input circuits involving connection of wires 132 and 136. The third input for the relay PM1 is provided by wire 137 which is selectively connected to a terminal in an hour matrix so as to obtain energy of a positive polarity from the hour stepping switch 103. Upon applying energy to all three of these inputs, the relay PM1 becomes picked up and energy is applied from wire 137 through front contact 138 of relay PM1 and wire 139 to output relays 140 for the control of a program controlled device such as the device 108 or 109 of FIG. 1.

With reference to FIG. 3, the system apparatus as heretofore described can be contained in a cabinet 141 preferably adapted for wall mounting, having a hinged door 142. The programming system is conveniently combined with a master clock control system, and thus the cabinet contains a master

clock indicating system time on a clock face 143. In connection with the master clock, an accumulator is provided for indicating the extent to which the system time is slow during times of power interruption. This accumulator has a face 144.

The stepping switches 101, 102 and 103 of FIG. 1 are mounted on a panel 145 in the cabinet 141, each of the stepping switches having an indicating pointer on the panel to indicate the position of the associated stepping switch. Thus the minutes switch 101 of FIG. 1 has an indicating pointer 146 on the panel 145, the hours stepping switch 102 has an indicating pointer 147, and the days stepping switch 103 has an indicating pointer 148. It will be noted that the indicating pointer 148 for days is a three-way pointer in that the stepping switch 103 that is used has 21 steps, and thus it takes 3 weeks for a complete revolution of this switch. The steps are therefore divided into three similar seven step sections, which have corresponding steps connected in multiple. Each of the stepping switch pointers 146, 147 and 148 can be rotated manually under conditions where it is desirable to check the programming of any of the programmed circuits in a manner to be hereinafter more specifically considered.

Output control panels 149 are provided in the cabinet for use in indicating and manually controlling energization of output control circuits that are programmed by the system. Each of these panels 149 has indicator lamps 150 and switches 151 for use in indicating and manually controlling two output control circuits of the system.

Below the panels 149 are disposed elevationally, and one in front of the other, first and second matrix modules 152 and 153. Each of these modules has a terminal panel such as panel 154 of module 152 (see FIG. 4) to which are secured a plurality of terminals such as the terminal 133 in rows and columns forming matrices as shown in FIG. 2. The terminal 133, i.e., has a plug portion 133a extending through an opening in the panel 154, and the terminal 133 is secured to the panel by ears 133b extending through the panel 154 and swaged over on the back side of the panel. A plurality of slots 133c are formed in the front side of terminal 133 for receiving quickly detachable connectors of the gates, such as the connector 129. Thus the back panel 154 can be considered as having wire terminals secured thereto corresponding to the terminal 133 of FIG. 4 in rows and columns and to an extent illustrated in FIG. 2. These terminals of module 152 have connections to their corresponding output circuits of the stepping switches in a manner similar to that which has been described for the connection of the terminal 133 of FIG. 4 to an output circuit for Monday of the days stepping switch 103.

The panel 154 is secured to a frame 155 (see FIGS. 3 and 5) which extends about the periphery of the panel 154 having front and rear inside flanges 155a and 155b against which front and rear panels 156 and 154 respectively are secured. The front panel 156 of the module 152 has apertures therein corresponding to apertures 157 shown in a corresponding front panel 158 of the front module 153 (see FIGS. 3 and 5).

Each of the modules 152 and 153 comprises a row of relays including the relay PM2 in the module 153 and the relay PM1 in the module 152 as shown in FIGS. 3 and 5. These relays are preferably potted in plastic with detents 159 formed therein which fit into apertures in associated rear panels to provide for detachably securing the relays between front and rear panels. It will be noted that the depth of the relays are made to be substantially equal to the inside measurement between the front panel 158 and the rear panel 160 of the module 153 so that when the front panel is secured in place, the relays are maintained in position because of their detents 159 being retained in openings in the associated rear panel. Relays can be readily removed from the module 153 by the removal of the front panel 158 which serves as a cover, and is detachably secured to the frame 155.

To facilitate the plug coupling of one module to another, registration pins 161 are provided in the rear of each module as shown in FIG. 5 to facilitate the alignment of the contacts of the second module with openings in the front panel 156 of the

first module to permit wire terminal 162 of the module 153, i.e., to be plug coupled to a corresponding terminal 133 in the module 152. When first and second modules are plug coupled together as is illustrated in FIGS. 3 and 5, the modules are latched in place by latches at both sides (see FIGS. 3 and 6) which can be disengaged readily for the removal of the front module by depression of latch control pins 163. The pins 163 are secured to angular leaf spring latches 164 which are in turn secured by rivets 165 to the side members of the frame of the associated modules. The springs 164 have detents which extend through openings of the rear panel of the associated module and the front panel of the adjoining module to latch with the frame of the adjoining module by a hook shaped end at point 164a which engages back of a flange 155a of the adjoining module.

Although it is contemplated that the program modules be similarly constructed, the first module to be inserted in the cabinet 141 must have all of its matrix terminals connected to the several outputs of the stepping switches, and thus this module probably would not be removed for changing a program. Therefore, rather than the first module being plug coupled into the cabinet, this module can be secured by screws to suitable supporting brackets (not shown) in the cabinet 141.

To consider a typical mode of operation of the system for setting up new programs, it will be assumed that it is desirable to add program controlled circuits to the system that has already been installed and is in operation as is illustrated in FIG. 3. The person wishing to program the circuits to be added obtains a program module like the modules 152 and 153 that have been described. He then removes the front panel and proceeds to designate the desired programs at a convenient location which may be in his office at a point remote from the location of the cabinet 141.

With the front panel of the module to be programmed removed, a relay is inserted in the module for each additional control circuit to be programmed in the system. Each of the three input wires of each relay is detachably connected to a selected terminal in the associated module as has been described to provide for that relay to deliver an output at the desired day, hour and minute. The single output wire for each relay is also detachably connected to a terminal for that control circuit in the associated module. The front panel is then secured to the module, and the module to be added is plug coupled to the front of module 153 in the cabinet 141, and immediately the newly programmed circuits are connected into the system. The new programs are thus added to the system without disturbing prior programmed circuits that are to be retained. It will be readily apparent that the added programs are not necessarily limited to programs for added circuits, but they can be modifications of existing program circuits to render such circuits also operable at a newly designated time.

Any program circuit can have its program checked without delivering an output from the circuit by first actuating the switches 151 for the circuits to a position disconnecting the circuits from their associated devices and connecting such circuits to respective indicator lamps 150 associated therewith. Thus, for example, with reference to FIG. 4, the actuation of the switch 151 to its left-hand position connects the output of the program relay PM1 to an associated indicator lamp 150 so that this lamp 150 becomes illuminated when the stepping switches are actuated to positions called for by the three input circuits to relay PM1. Thus, with the switches 151 in their positions for connecting the indicator lamps, the pointers 146, 147 and 148 can be rotated to positions corresponding to the time intended to be programmed, and the illumination of indicator lamp 150 for that program will confirm that the program has been properly designated. After checking is completed, the stepping switch dials should be reset to the correct time, and the switches 151 actuated to their right-hand positions to render the control of devices such as 108 and 109 effective according to the selected programs. The stepping switches may be free to be operated manually at any time, or they can be locked to permit manual operation only when a

release button, or the like is actuated in accordance with the requirements of practice.

While there have been described what are at present considered to be the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein, without departing from the invention, and it is, therefore, aimed in the appending claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

1. A programmed timing system for selective energization of a plurality of control circuits comprising in a cabinet timing means driving day, hour and minute stepping switches which have output circuits successively energized as time progresses wherein the improvement comprises;

a panel for the cabinet having receptacle openings therein corresponding to the day, hour and minute stepping switches,

one or more matrix modules comprising, a rear panel for one side of the module supporting groups of plug connector terminals in rows and columns corresponding with respective day, hour and minute receptacle openings, said matrix modules adapted for quickly detachable connection to the several output circuits of the stepping switches and a front panel for the opposite side of the module having receptacle openings formed therein corresponding with plug connector terminals of any other matrix module, to permit the plug coupling of terminals of another matrix module to the terminals of any other matrix module,

a plurality of gates mounted on and for each of the matrix modules for delivering outputs to the several control circuits, each of the gates having a plurality of inputs detachably connected to selected connector terminals of the matrix modules for programming selected times for energization of the outputs circuits,

whereby programs for the control circuits can be designated in modules before detachably connecting the terminals of that matrix module to the cabinet panel and terminals of any other matrix module such that the module may be detachably stacked one against the other into the cabinet panel for expanding the capability of the system; and said matrix modules further include: a unidirectional device and an auxiliary wire terminal that is connected to detachable connectors to several of the other wire terminals of the associated matrix through said unidirectional device, and an input to one of the gates is detachably connected to the auxiliary wire terminal.

2. The invention according to claim 1 wherein each of the gates has input wires detachably connected to a selected one of each of the several columns of terminals.

3. The invention according to claim 1 wherein the gates of the second matrix module are relays, each relay having its winding connected across selected ones of the terminals energized by outputs from two of the stepping switches respectively and having an output circuit energized through a contact of the relay from an output of a third stepping switch.

4. The invention according to claim 3 wherein each of the relays is detachably secured to the one of panels of the matrix modules.

5. The invention according to claim 1 wherein indicating means is associated with each of the control circuits for indicating when an output for a control circuit is enabled by the associated gate and means is provided for manually rotating the stepping switches independent of the operation of the clock to obtain an indication in the indicating means for verifying the programming of the associated control circuit.

6. The invention according to claim 1 wherein the gates are AND gates.

7. The invention according to claim 6 wherein one of the inputs to each of the AND gates is of opposite polarity as compared to the other inputs.

8. The invention according to claim 7 wherein at least one of the AND gates comprises a relay for governing energization of the control circuits.

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9. The invention according to claim 8 wherein the relay has its winding connected across inputs of opposite polarity from first and second groups of connected terminals of the matrix and energy over the relay contact from a third group.

10. The invention according to claim 1 wherein at least one of the control circuits is connected to a plurality of terminals

of one of the matrices through AND and OR gates connected in series.

11. The invention according to claim 1 wherein said unidirectional device is a diode.

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