

July 21, 1942.

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2,290,732

ELECTRICAL SWITCHING, TIMING, AND SYNCHRONIZING APPARATUS

Filed Dec. 24, 1938

2 Sheets-Sheet 1

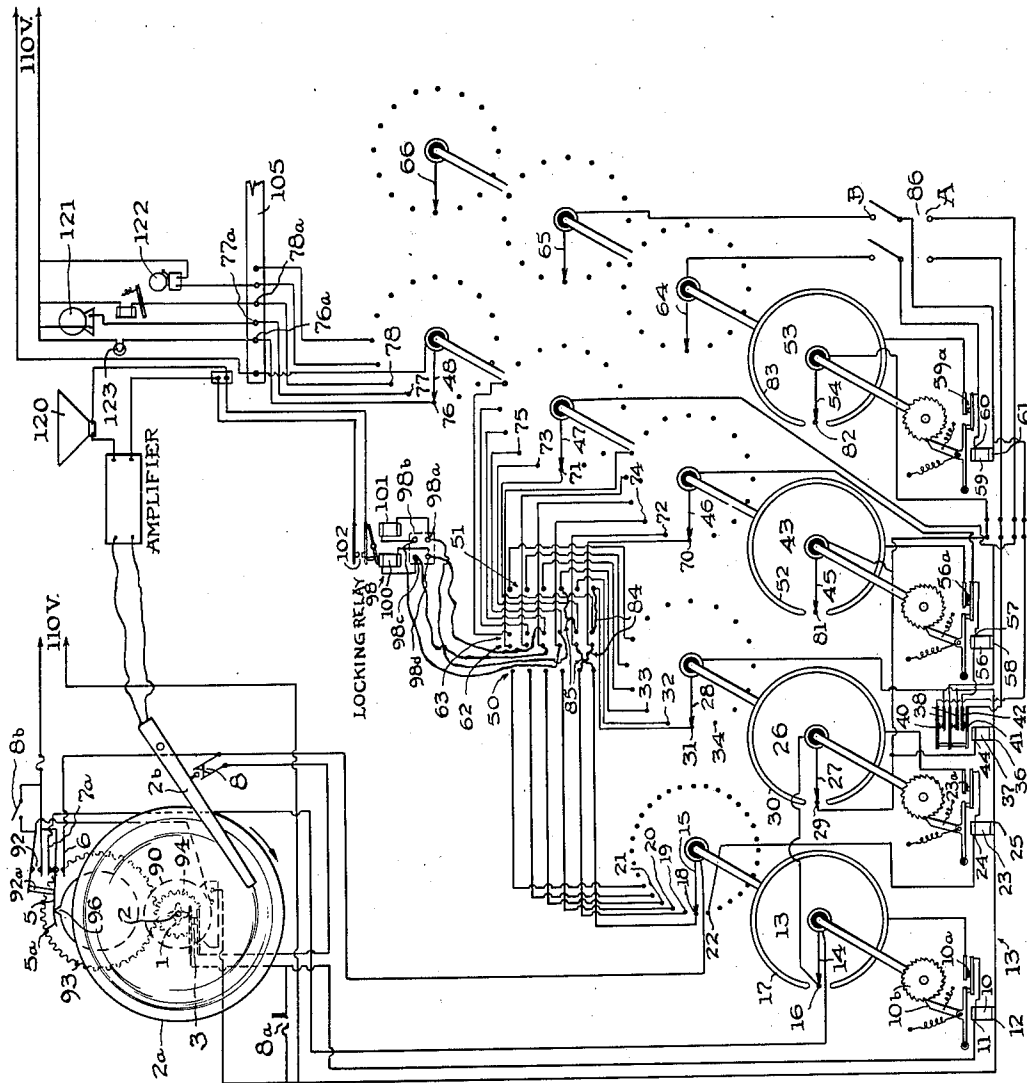


Fig. 1.

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July 21, 1942.

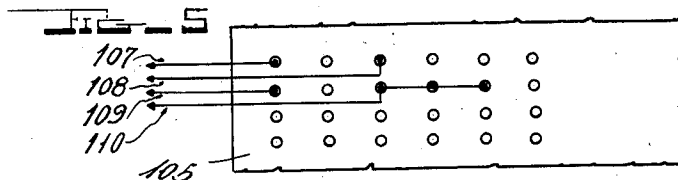
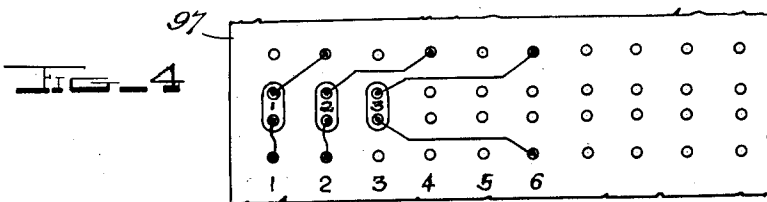
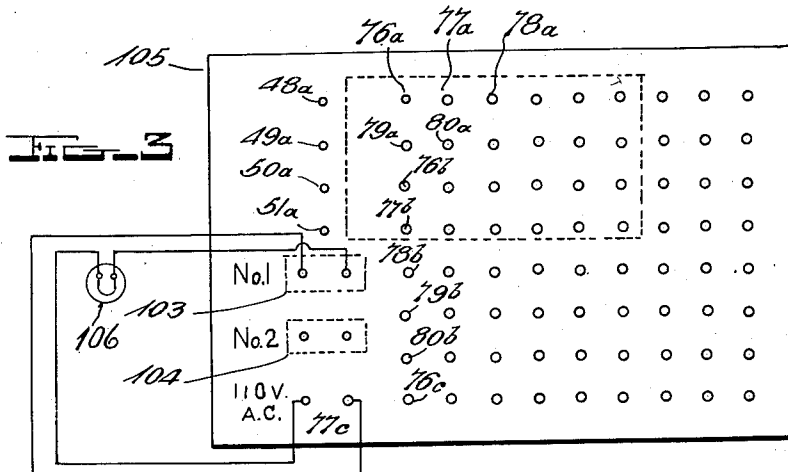
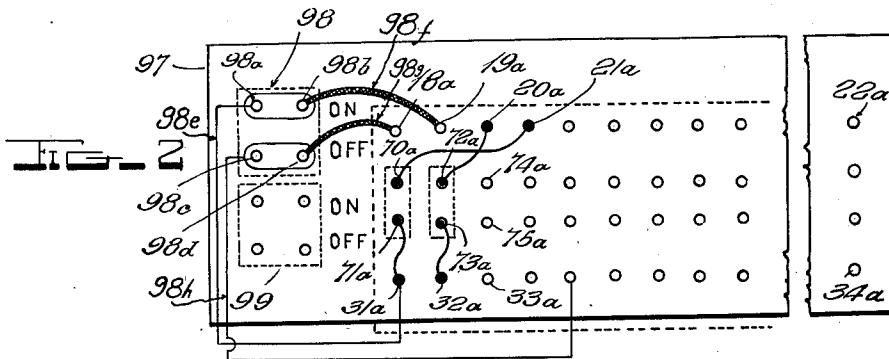
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,290,732

ELECTRICAL SWITCHING, TIMING, AND
SYNCHRONIZING APPARATUS

Ernest Barton Elett, Chicago, Ill.

Application December 24, 1938, Serial No. 247,685

13 Claims. (Cl. 171--97)

This invention relates to electrical apparatus generally. More particularly this invention relates to electrical switching apparatus adapted to be used in conjunction with various methods of reproducing sound to produce or arrange to produce various actions in synchronism with or properly timed with respect to said sound reproduction.

An object of this invention is to provide a timing arrangement which may be employed to control a plurality of circuits of various electrical devices in definite time relation for the production of predetermined results or effects by the cooperation of predetermined ones of said devices and a sound reproducing device.

Another object of this invention is to provide a timing apparatus driven by a substantially constant speed motor, said timing apparatus including step-by-step switch apparatus which is actuated to control the energization or de-energization of predetermined circuits at selected intervals, during a large part of the cycle of operation of the timing apparatus, said timing apparatus being adapted to energize a resetting circuit for resetting the step-by-step switch apparatus during the remaining part of the cycle of operation of the timing apparatus.

Another object of this invention is to provide a motor driven timing arrangement in which the motor drives a suitable electrical impulse producing arrangement connected to predetermined circuits to be controlled, said motor also being provided with interchangeable mechanical motion transmission devices which are operated to control the resetting circuit or circuits of the step-by-step switching devices at proper intervals depending upon the results desired to be produced by the step-by-step switching devices and the apparatus controlled thereby.

Other and further objects of this invention will be apparent from the following specification and the claims.

In accordance with this invention I have devised an apparatus that is extremely flexible and easily adapted to the time control of many different devices whereby different ones of said devices may be operated for different lengths of time either simultaneously, consecutively or in a predetermined sequence. My apparatus was primarily devised to be used with robot phonographs although it has numerous applications with sound reproducers other than the conventional phonograph type, for example, it is obvious that this apparatus may be used with film, tape

and wire sound record reproducers, as well as by itself.

Another feature of my invention is that many more devices may be controlled or operations performed by two or more step-by-step switching devices having a limited number of contacts than was heretofore possible. This is accomplished by a novel circuit arrangement in which a step relay having a plurality of banks of stationary contacts is connected to be operated to make or break an electrical circuit through those stationary contacts only as needed. Thus the wipers associated with the plurality of banks of contacts are not needlessly shifted over said contacts but are shifted only when a circuit is to be established or broken. This is accomplished by connecting both of the terminals of the solenoid to wipers controlled by the solenoid and in this way interrupting both sides of the solenoid after each time the solenoid is energized to move said wipers. This is, of course, described in detail in the following specification.

Another feature of the apparatus of my invention may be readily made to carry load currents without difficulty and thus eliminate the necessity, in most cases, of using power relays. This is made possible by the efficient use of the contacts of the load switching device.

These and various other features of this invention will be apparent to those skilled in the art to which the invention relates from the following specification and claims.

Referring to the drawing forming a part of this specification, briefly, Fig. 1 illustrates a schematic diagram of connections showing features of my invention; Fig. 2 is a fragmentary view of the timing jack board; Fig. 3 is a fragmentary view of the load terminal board; Fig. 4 is a view of the timing jack board used for the purpose of explaining this invention and Fig. 5 is a view showing a set of connections on the load terminal board.

Referring to Fig. 1 in detail reference numeral 99 designates an electric motor provided with a shaft 2 for rotating the cam 1 which is used to close the switch 3 periodically to send electric current impulses through the solenoid 10. The switch closing cam 1 is provided with four points for closing the switch 3 four times during each revolution. The motor 99 is of the synchronous alternating current type although any constant speed motor may be employed. A small gear wheel 94 is mounted on the shaft 2 and is arranged to drive the large gear wheel 93 mounted on another shaft (not shown). The reset-switch-

operating cam 96 is also mounted on the shaft of the gear 94 in such a way that the off-set portion of the cam 96, actuates the arm 5a of the reset switch at the proper time and for the correct interval during which the step-by-step switches 13, 26, 43 and 53 are electrically reset to their starting positions. During this resetting interval the circuit between the contact of arm 5a and the contact 7a is completed (as shown) so that the wiper contact 14 of the step-by-step switch 13 is connected to the 110 volt circuit. The circuit between the arm 5a and the contact 6a is at the same time interrupted. A piece of insulation material 92a is provided between the arm 5a and the switch 92 to open this switch during resetting of the step-by-step switches. Thus if the switch 9b, connected across the limit switch 92, is open the apparatus will stop at the time of resetting. The resetting operation will be described more fully in a following paragraph.

The impulse switch is associated with a four cornered rotatable cam-like member 1 mounted upon a shaft 2 which may be the shaft of a phonograph turn table 2a or other sound record driving motor. This cam-like member may be formed in other shapes than the four cornered shape illustrated and the shape thereof determines the number of times that the impulse switch 3 is closed for each revolution of the shaft 2. In the case of the three cornered cam-like element the switch 3 will be closed three times for each revolution of the shaft 2. One of the contacts of the switch 3 is connected to the contact 6 of the re-setting switch. During the normal operating position of the re-setting switch the contact 5 thereof which is connected to the 110 volt line, makes connection with the contact 6 so that the impulse switch 3 is connected to the 110 volt line. The switch 3 is also connected to the starting switch 8. The other contact of switch 3 is connected to the terminal 11 of the solenoid 10 forming a part of first step by step switch 13. The starting switch may be operated in various ways as by a deflection groove of a sound record shifting the tone arm or pick-up arm 2b which carries or manipulates this switch as illustrated or it may be operated manually. The other terminal 12 of this solenoid is connected to the other side of the 110 volt line and in this way the solenoid 10 is periodically energized through the impulsing switch 3 as the shaft 2 is rotated. This solenoid 10 is provided with an armature that is mechanically coupled to the wiper contacts 14 and 15 by a suitable pawl and gear mechanism 10b so that each time an impulse is transmitted to the solenoid 10 the wiper contacts 14 and 15 will, by means of this pawl and gear mechanism, be advanced by one step. Thus if the wiper contact 14 is in engagement with the contact 16 it will be advanced to contact the re-setting ring 17 when an impulse is transmitted to the solenoid 10. Likewise the wiper contact 15 will at the same time be advanced from the stationary contact 18 to the stationary contact 19. The stationary contacts 18, 19, 20 and 22 are preferably positioned in a circle with the wiper contact 15 pivoted in the center so that this wiper contact may engage these contacts consecutively while being rotated. This circle is preferably arranged to include fifty contacts, the fiftieth contact designated by the reference numeral 22 being connected to the terminal 24 of the solenoid 23 of the second step by step switch 26. This second step by step switch 26 is similar to the switch 13 in that the solenoid 23

also controls two wiper contacts 27 and 28. The wiper contact 27 is associated with a split ring 30 and a small segment contact 29 positioned between the ends of the split ring 30. The member 17 of the switch 13 is also formed in the shape of a split ring with the segment contact 16 positioned between the ends thereof. The wiper 28 like the wiper 15, is associated with a group of segment contacts positioned in a circle about the pivoting point of this wiper. The contacts 31, 32, 33 and 34 are included in this group and the number of contacts in this case may vary depending upon the nature of the switching operations to be carried out. The wiper contact 28 is connected to the wire 35 which is connected to the terminal 12 of the solenoid 10, the terminal 25 of the solenoid 23, the terminal 36 of the solenoid 27 and the contacts 39 of the relay 39. The contacts 38 and 40 of this relay are normally open whereas the contacts 41 and 42 are normally closed. The principal purpose of relay 39 is to isolate switch 43 and switch 53 (when used) so that there are no effective connections between switch 43, and switch 53 (when used) to switches 13 and/or 26 except through patchcords during the operating cycle and to common switch 43 and switch 53 with switches 13 and 26 during the re-setting period. This relay also breaks the parallel circuit, when switch 26 is in "A" position, of solenoids 56 and 59 so that switches 43 and 53 may re-set independently. The contact 29 is connected to the terminal 44 of the relay coil 37, to the wiper contact 45 of the step by step switch 43 and through a suitable plug and jack to the wiper contact 54 of the step by step switch 53.

The mechanical details of construction of the step by step switches 43 and 53 are similar to the switches 13 and 26 in that they are fundamentally of the solenoid controlled step by step types similar to those developed by Strowger. While the wiper contacts of these step by step switches are shown in open circuit position, actually they never rest in a position where they do not engage a contact. The switches 43 and 53 differ from the switches 15 and 36 in that a larger number of wiper contacts is employed. In the case of the switch 43 wiper contact 45 is associated with the re-set ring 52 similar to the rings 17 and 30. Wiper contacts 46 and 47 are associated with rows of stationary contacts employed for timing purposes, that is, to control the timing of the operation of the switch 43 as will be described in detail. Wiper contacts 48, etc. are associated with so called load terminals. While only one wiper contact 48 and associated stationary contacts are illustrated it is of course understood that several sets of these may be employed. It will be seen from the diagram of connections that the wiper contacts 46 and 47 are connected to the terminals 57 and 58 respectively of the solenoid 56 which controls the operation of the wiper contacts of the switch 43. Furthermore the terminal 57 of the solenoid 56 is also connected to the relay contact 42 which is normally in engagement with the relay contact 41 that is connected to the terminal 60 of the solenoid 59 through the plug and jack arrangement. The terminal 61 of the solenoid 59 and terminal 53 of the solenoid 56 are connected to the relay 37 and to the wiper contact 47 as shown. It will thus be seen that during normal operation the solenoid 59 is connected in parallel with the solenoid 56 and also to the wiper contacts 46 and 47. Thus during normal operation the step by step

switches 43 and 53 are made to operate together when the switch 86 is in position A.

The switching mechanism 53 is provided with a plurality of wiper contacts 54, 64, 65, and 66. The wiper contact 54 is associated with the reset ring 83 which is a split ring and has segment 82 positioned between ends thereof. The wipers 64 and 65 are arranged to perform a dual function in that these wiper contacts may be connected across the solenoid 59 through the double throw switch 86 when this switch is in the position designated by B. When this switch is in this position the function of the switching mechanism 53 may be timed through connections made to the contacts associated with the wipers 64 and 65 in the same manner as the switch 43 is timed through the use of patch cords 84 and 85. The stationary contacts associated with the wiper 46 are connected to one or more rows of jacks or terminals, such as, the vertical row 62 and likewise the contacts associated with the wiper 47 are connected to the vertical terminal row 63. The stationary contacts of switches 13 and 26 are connected to terminal rows 50 and 51, respectively. Having the contacts arranged on a terminal board in this way facilitates use of the patch cords 84 and 85. Although it is possible to make these connections directly to the stationary switch contacts it is preferred to employ these patch cord connectors in conjunction with suitable jacks that are mounted on a board 97 shown in Fig. 2. These jacks are of a conventional construction and therefore no detailed showing is made thereof aside from their arrangement on the panel 97 shown in Fig. 3. It will therefore be seen that connections must be made from the various stationary contacts employed for timing purposes and associated with the switches 13, 26 and 43, with the jacks on the panel 97. Thus the stationary contacts 18, 19, 20, 21 and 22 of the switch 13 are connected to the jacks 18a, 19a, 20a, 21a and 22a, respectively, corresponding to terminal row 50, Fig. 1. The contacts 31, 32, 33 and 34 are likewise connected to the jacks 31a, 32a, 33a and 34a, respectively, corresponding to terminal row 51, Fig. 1. The two rows of timing contacts including the contacts 70, 71, 72, 73, 74 and 75 of the switch 43 are connected to the center rows of jacks 62 and 63, respectively, including the jacks 70a, 71a, 72a, 73a, 74a and 75a, respectively. An arrangement such as this facilitates the use of the patch cords 84 and 85 and additional cords when necessary inasmuch as the plugs 84a and 85a carrying two terminals may be easily inserted into the center rows of jacks. The red and black patch cords associated with the plug may be easily inserted into the desired jacks either in the top or the bottom row, Fig. 2. Patch cords of two different colors are employed in order to eliminate confusion when a large number of cords are used. If cords of two colors such as red and black are used then care is taken to associate all of the cords of one color with the top two rows of jacks and all of the cords of the other color with the bottom two rows of jacks.

When the switch 86 is in the A position the solenoid 59 of the switch 53 is connected in parallel with the solenoid 56 of the switch 43 and the timing of the switch 53 is controlled by the connections made to the switch 43 through the patch cords 84 and 85. In this case the wiper contacts 48, etc. of the switch 43 as well as the wiper contacts 64, 65, 66, etc. of the switch 53 are employed for the purpose of controlling load circuits. A

load terminal board 105 carrying a plurality of binding posts or similar devices is associated with the contacts of the switch 43 and the various load circuits to be controlled are connected to the terminals of this board. A similar terminal board is associated with the contacts of switch 53. The wiper contacts 48, etc. of the switch 43 are connected to the terminals 48a, 49a, 50a and 51a, respectively of the board 105. Likewise the contacts 76, 77, 78, etc. are connected to the terminals 76a, 77a, 78a, 79a and 80a of the board 105. Additional stationary contact banks of the switch 43 may be connected to the terminals 76b and 80b of the board. In order to utilize the terminal space of the board 105 more efficiently eight rows of terminals are provided to accommodate additional stationary contact banks associated with additional wiper contacts provided to the switch 43. Switch 53 also may be provided with additional banks of stationary and wiper contacts and this is of course desirable in practice in order to control a multiplicity of circuits and devices. It is of course obvious that any convenient terminal arrangement may be employed other than that illustrated herein and that different applications of this switching arrangement may make it desirable to employ arrangements of terminals, jacks and contacts, other than those herein illustrated.

During the normal operation of this apparatus when the switch arm 5a is connected to the contact 6a so that the impulse producing switch 3 is operative, the solenoid 10 receives electrical impulses from this switch 3 and advances the wiper contact 14 over the resetting ring 17 and the wiper contact 15 over the stationary contacts 18, 19, 20, 31 and etc. When wiper contact 15 momentarily engages stationary contact 21, the wiper 28 being in contact with 31, an electrical impulse is sent through the patch-cords 84 to the solenoid 56 through the wiper contacts 46 and 47. This causes the solenoid 56 to advance the wiper contacts 46, 47, 48, 49, 50 and 51 from the first vertical row of stationary contacts to the second vertical row of contacts and any electrical devices that may be connected to these first and second vertical rows of contacts will of course be either energized or de-energized in accordance with the manner in which they are connected.

If the solenoid 59 of the switch 53 is connected in parallel with the solenoid 56 of switch 43 by reason of switch 86 being in position A, when the wiper contacts of switch 43 are advanced the wiper contacts of switch 53 will be similarly advanced. When the wiper contact 15 of switch 13 momentarily engages the stationary contact 22 an electrical impulse is transmitted to the solenoid 23 of the step-by-step switch 26 causing the wiper contacts 27 and 28 to be advanced one step so that wiper contact 28 engages stationary contact 32. When the wiper contact 15 of the switch 13 engages stationary contact 29 during the second cycle of switch 13, the solenoid 56 of the switch 43 will again be energized, this time through the patchcords 85. Consequently the wiper contacts are again advanced and the load circuits connected to the switches 43 and 53 are altered in a manner depending upon the connections to these switches.

Assuming the frequency of impulses from switch 3 to be such that switch 13 completes one cycle every thirty seconds the wiper of switch 26 would move one step every thirty seconds. If it were not desired to alter load circuits until

two full minutes after that alteration caused by patchcords 85 the next operation could be caused by connecting a set of patch cords to stationary contacts 74 and 75 of switch 43 and by means of a multiplug to stationary contact 29 of switch 13 and to the 4th stationary contact to the right of stationary contact 32 of switch 26. It can be seen that it is not necessary to move switch 43 except when it is desired to alter a load circuit. In similar devices where a plurality of step-by-step switches are used, one or more of which are used to switch load circuits it is necessary to move the switch to which the load circuits are connected once during each cycle of the fastest moving step-by-step switch whether it is desired to switch a load circuit or not. This defect is overcome by the improved circuit of my invention described above.

It will be seen that a large number of patch cords can be connected between the timing terminal associated with the wiper contacts 46 and 47 of the switch 43 and the timing terminals of the switches 13 and 26. These connections are made on a suitable jack board as illustrated in Fig. 2. Additional patch cord similar to the cords 84 and 85 may be used and the next patch cord would of course make contact with 74a and 75a of the terminal board. Employing two rows of contacts associated with the wiper contacts 46 and 47 for the purpose of timing and controlling the energization of the solenoid 56 of the switch 43 is an important feature of my invention. The advantages gained from this feature include the absolute elimination of erratic operation of devices of this character. Furthermore the contacts associated with the wiper contacts of the switch 43 and the switch 53, when used, may be much more economically arranged and used and a greater number of load circuits may be controlled with a much more limited number of contacts than was possible with similar switching devices heretofore developed.

When this apparatus is employed with a robot phonograph show the various devices thereof including the phonograph loudspeaker 120, motor 121, bell 122, light 123 and the like, are controlled at proper intervals through connections to the load terminals associated with switches 43 and 53. After the robot phonograph show performance is completed it will be seen that the wiper contacts associated with each of the step-by-step switches will be contacting various ones of the stationary contacts associated therewith. It is of course obvious that after one performance of the show is completed that repetition thereof will be desired and in many instances the repetition should take place automatically.

The mechanism may be arranged to repeat its cycle of operation indefinitely as long as it is connected to the 110 volt circuit and the motor 90 drives the impulse producing cam and the reset switch operating cam. Where desired the motor 90 may be used to drive the turntable of the phonograph or the sound record carrying strip in connection with which this invention may be used. While the performance is taking place the reset switch arm 5a is in contact with the contact 6a so that the circuit of the impulse producing switch is energized from the 110 volt circuit. When the cam 96 is rotated so that the portion 96a moves the arm 5a into engagement with the contact 7a the resetting circuits of the step-by-step switches 13, 26, 43 and 53 are energized inasmuch as the wiper contact 14 of the

switch 13 is connected to the contact 7 of the reset switch. This wiper contact 14 is in engagement with the split reset ring 17 which is connected to the solenoid 10 through the switch 10a. When the solenoid 10 is energized the switch 10a is opened through the action of the magnetic field set up in the solenoid and the armature associated with this solenoid. When the switch 10a is opened the solenoid is of course de-energized and the switch consequently is allowed to close again. Thus the solenoid 10 is periodically energized and de-energized so that it operates its step by step mechanism and actuates the wiper contacts 14 and 15 until the wiper contact 14 engages the segment 16. When the circuit between 14 and 16 is closed the wiper contact 27 of the switch 26 is connected to the contact 7 of the reset switch and if the wiper contact 27 is in engagement with the reset ring 30 the solenoid 23 is periodically energized through the switch 23a, as in the case of the solenoid 10, until the wiper contact 27 engages the segment 29. During this time the solenoid 10 of the switch 13 is de-energized. When the circuit is complete between the contacts 27 and 29 the solenoid 56 of the switch 43 is energized through the wiper contact 45, the reset ring 52 and the switch 56a. The switch 43 is thus reset, the wiper contact 45 brought into engagement with the segment 81 and the circuit between the other wiper contacts of the switch 43 and the first vertical row of stationary contacts is completed. The solenoid 59 of the switch 53 is energized for the purpose of resetting the wiper contacts thereof in the same manner as the wiper contacts of the other step by step switches were reset. The time interval in which these resetting operations are performed is relatively short and is made to correspond to the length of time or less during which the off-set portion 96a of the cam 96 maintains the contact arm 5a in engagement with the contact 7a. Thus when the reset operation is completed the timing mechanism will be in condition to close the circuit between the arm 5a and the contact 6a so that the cycle of operation may be performed all over again by the step by step switches and the associated mechanism. The switches 43 and 53 are connected to be reset simultaneously inasmuch as this is desirable in the case of the load switches. However these switches may be arranged to be reset progressively by connecting the wiper 54 of switch 53 to the contact 81 of switch 43 instead of the wiper 45. Additional units such as switch 53 may be connected to this apparatus and these may be connected to the apparatus in the same way as switch 53 if desired.

A locking relay 98 may be conveniently employed in connection with this invention. Two or more of these relays designated by 98 and 99 are mounted on the panel 97 shown in Fig. 2. Each of these relays is provided with four jacks, those associated with the relay 98 being designated by reference numeral 98a and 98b which are connected to the "on" coil 101, and the jacks 98c and 98d which are connected to the "off" coil 100. The armature contacts 102 controlled by the coils 100 and 101 are connected to terminals 103 that are mounted on the terminal board 105. The terminals 104 of the relay 99 are mounted directly below the terminals 103 and terminals 107c connected to the 110 volt source of supply are positioned below the terminals 104.

In a robot phonograph show with which this invention is adapted to be used it is sometimes

necessary to turn a flood light or some other device on at or near the start of the show and not turn it off until the end. Often it is desirable to do the same thing with loud-speaker circuits or to use several loud-speakers switching from one to the other at the appropriate time. During the time these circuits are to be kept closed the wiper contacts of switch 43 and/or 53 may be moved many times in order to switch other load circuits. If a flood light, for an example, is handled by one of these switches it would be necessary to connect all the contacts of one level, contacted by the corresponding wiper, during the period it is desired to have the flood light on so as to maintain the flood light circuit. The use of a locking or interlocking relay to handle the flood-light circuit makes this contact level of switch 43 or 53 available for use to control other circuits.

Suitable patch cords 93e and 93f are used to connect the "on" coil of the relay 98 to the timing contacts, that is, the jacks connected to the stationary contacts of the switches 13 and 26, said jacks being mounted on the board 97. Likewise patch cords 93h and 93g are used to connect the "off" coil of the relay 98 to the desired timing jacks. With the location of the relay patch cords illustrated in Fig. 2 the "on" coil of the relay would be energized at the second impulse of switch 13, since it is connected to the second contact of switch 13 and to the first contact of switch 26. The "off" coil would be energized at the two hundred and first impulse because this coil is connected to the first contact of switch 13 and to the fifth contact of switch 26. The switch 26 is advanced one contact each time the switch 13 is advanced fifty. A convenient way of counting these impulses is provided at jack 8a which enables an electrically actuated counting device, for example, of the type described in United States Patent No. 314,914 to Brown et al., to be connected across the solenoid 10. Thus the number of impulses that the switches are advanced may be counted so that a record of the timing of a robot phonograph show may be had and the correct patch cord positions for the locking relays as well as for the timing circuits of switches 43 and 53 may be obtained. This impulse counting device reading may be converted directly into time when the rate of rotation of the switch cam 1 is known.

The flood light 106 shown in Fig. 3 is connected to the contacts 103 of the locking relay 98 and to the 110 volt terminals 77c also mounted on the board 105. In this way the relay 98 controls the energization of the flood light. The relay 99 may control other apparatus in a similar manner and contacts 104 are provided for this purpose.

In Fig. 4 I have shown a fragment of the board enclosed by the broken line in Fig. 2 for the purpose of illustrating the timing of the switch mechanism.

The timing shown in Fig. 4, assuming the jacks to be numbered as shown in this figure, is as follows: patch-cord 1 connected between jack 2 on top row and jack 1 on bottom row would function at the first impulse to close a circuit that was connected between the second vertical row of load terminals and the corresponding wiper terminal, or open a circuit connected between the first vertical row of load terminals and the corresponding wiper contacts. Patchcord 2 connected between jack 4 on the top and jack 2 on the bottom would function to close a circuit that was connected between the appropriate wiper

terminals and third vertical row of load terminals, at the fifty third impulse and/or open a circuit connected between the wiper terminals and the second vertical row of load terminals. Patchcord 3 connected between jack 6 on the bottom and jack 6 on the top would close at the 255th impulse a circuit that was connected between fourth vertical row of load terminals and the corresponding wiper terminals, or open a circuit connected between the wiper terminals and third vertical row of load terminals. The patchcords here shown correspond to patchcords shown in Fig. 2 except that they occupy different positions.

The section of the terminal board shown in Fig. 5 is the portion of the terminal board shown in Fig. 3 enclosed by the broken line. Wires 107, 108, 109 and 110 are connections leading from the various terminals on the board to electrically energize devices to be controlled. Wire 110 is connected to three load terminals indicating that the device connected to this wire is to be energized or under a predetermined state of control throughout the interval during which the wiper contact passes over the stationary contacts of switch 43, for example, corresponding to these load terminals.

While I have described an embodiment of this invention in detail it is of course understood that I do not desire to limit the invention to the exact details set forth except insofar as they are defined by the claims.

What I claim is as follows:

1. Electrical switching apparatus for timed switching, comprising: a substantially constant speed motor, an impulse producing switch driven by the shaft of said motor, timing means including a gear train connected to be driven by said motor, a step-by-step switch having a solenoid connected to said impulse producing switch, auxiliary switch means connected to said step-by-step switch for controlling actuating circuits of devices that are to be controlled at predetermined time intervals, means for resetting said step-by-step switch and said auxiliary switch means after a predetermined cycle of operation, and switch means actuated by said timing means for connecting said resetting means to a source of current supply for a predetermined interval while said motor is running whereby the cycle of operation of the switching apparatus may be repeated without the attention of any operator.

2. Electrical switching apparatus for timed switching, comprising: a substantially constant speed motor, an impulse producing switch driven by the shaft of said motor, timing means including a gear train connected to be driven by said motor, a step-by-step switch having a solenoid connected to said impulse producing switch, auxiliary switch means connected to said step-by-step switch for controlling actuating circuits of devices that are to be controlled at predetermined time intervals, said auxiliary switch means including a step-by-step switch connected to said first mentioned step-by-step switch to be advanced one step upon the completion of each cycle of operation by the first mentioned step-by-step switch, means for resetting said step-by-step switch and said auxiliary switch means after a predetermined cycle of operation, and means actuated by said timing means for connecting said resetting means to a source of current supply for a predetermined interval while said motor is running whereby the cycle of op-

eration of the switching apparatus may be repeated without the attention of any operator.

3. Electrical switching apparatus for timed switching, comprising: driving means comprising a substantially constant speed device, a step-by-step switch mechanism, means driven by said driving means for producing electrical impulses for actuating said step-by-step switch, said step-by-step switch having a wiper contact and a plurality of stationary contacts each of which are contacted by said wiper contact during a cycle of operation, a second step-by-step switch mechanism, connections between said second step-by-step switch mechanism and said first step-by-step switch mechanism for advancing said second step-by-step switch mechanism each time said first step-by-step switch mechanism completes one cycle of operation, a third step-by-step switch mechanism, connections between said third step-by-step switch mechanism and said first and second step-by-step switch mechanisms whereby said third step-by-step switch mechanism is advanced at predetermined intervals determined by both said first and second step-by-step switch mechanisms, and load circuits connected to be controlled by said third step-by-step switch mechanism.

4. Electrical switching apparatus for timed switching, comprising: driving means comprising a substantially constant speed device, a step-by-step switch mechanism, means driven by said driving means for producing electrical impulses for actuating said step-by-step switch, said step-by-step switch having a wiper contact and a plurality of stationary contacts each of which are contacted by said wiper contact during a cycle of operation, a second step-by-step switch mechanism, said second step-by-step switch having a wiper contact and a plurality of stationary contacts associated therewith, connections between said second step-by-step switch mechanism and said first step-by-step switch mechanism for advancing said second step-by-step switch mechanism each time said first step-by-step switch mechanism completes one cycle of operation, a third step-by-step switch mechanism, connections between said third step-by-step switch mechanism and the stationary contacts of said first and second step-by-step switch mechanisms whereby said third step-by-step switch mechanism is advanced at predetermined intervals determined by both said first and second step-by-step switch mechanisms, and load circuits connected to be controlled by said third step-by-step switch mechanism.

5. Electrical switching apparatus for timed switching, comprising: driving means comprising a substantially constant speed device, a step-by-step switch mechanism, means driven by said driving means for producing electrical impulses for actuating said step-by-step switch, said step-by-step switch having a wiper contact and a plurality of stationary contacts each of which are contacted by said wiper contact during a cycle of operation, a second step-by-step switch mechanism, said second step-by-step switch having a wiper contact and a plurality of stationary contacts associated therewith, connections between said second step-by-step switch mechanism and said first step-by-step switch mechanism for advancing said second step-by-step switch mechanism each time said first step-by-step switch mechanism completes one cycle of operation, a third step-by-step switch mechanism, said third step-by-step switch having a plurality of sets of

stationary contacts, contacts in a pair of said sets of stationary contacts being connected to the stationary contacts of said first and second step-by-step switch mechanisms whereby the timing of said third step-by-step switch mechanism is determined by both said first and second step-by-step switch mechanisms, and load circuits connected to be controlled by said third step-by-step switch mechanism.

6. Electrical switching apparatus for timed switching, comprising: driving means comprising a substantially constant speed device, a step-by-step switch mechanism, means driven by said driving means for producing electrical impulses for actuating said step-by-step switch, said step-by-step switch having a wiper contact and a plurality of stationary contacts each of which are contacted by said wiper contact during a cycle of operation, a second step-by-step switch mechanism, said second step-by-step switch having a wiper contact and a plurality of stationary contacts associated therewith, connections between said second step-by-step switch mechanism for advancing said second step-by-step switch mechanism completes one cycle of operation, a third step-by-step switch mechanism, said third step-by-step switch having a plurality of sets of stationary contacts in a pair of said sets of stationary contacts being connected to the stationary contacts of said first and second step-by-step switch mechanisms whereby said third step-by-step switch mechanism is advanced at predetermined intervals determined by both said first and second step-by-step switch mechanism, wiper contacts associated with each of said sets of stationary contacts, all of said last mentioned wiper contacts being actuated as a unit, and load circuits connected to selected contacts of said sets of stationary contacts to be energized as said last mentioned wiper contacts are actuated.

7. Electrical switching apparatus for timed switching, comprising: an electric motor of a substantially constant speed type, an electrical impulse producing switch adapted to be actuated by said motor, a first step-by-step switch having a plurality of stationary contacts, a rotatable wiper contact cooperating with said stationary contacts, a solenoid and armature for actuating said rotatable wiper contact, connections for connecting said solenoid in series with said electrical impulse producing switch and a source of current supply whereby said solenoid and armature are energized to advance said rotatable wiper in step-by-step fashion as said electrical impulse producing switch is actuated by said motor, a second step-by-step switch having a plurality of stationary contacts, a rotatable wiper contact cooperating with said last mentioned stationary contacts, a solenoid and armature for actuating said last mentioned rotatable wiper contact connections between one terminal of said last mentioned solenoid and one terminal of said first mentioned solenoid, connections between the other terminal of the solenoid of said second step-by-step switch and one of the contacts of said first mentioned switch whereby said solenoid of said second step-by-step switch is energized to advance said wiper contact associated therewith when the said wiper contact associated with said first step-by-step switch is moved over the aforesaid contact to which said solenoid of said second switch is connected, a third step-by-step switch having a plurality of banks of stationary contacts, a set of wiper contacts, a wiper contact of said set of wiper contacts being

associated with each of said banks of stationary contacts, a solenoid and an armature for actuating said set of wiper contacts, connections for connecting the solenoid of said third step-by-step switch to two of the contacts of the afore-said set of wiper contacts, means for connecting selected contacts of the banks of contacts associated with the last mentioned two of said set of wiper contacts to selected contacts associated with said first and said second step-by-step switches whereby the energization of the solenoid of said third step-by-step switch is controlled to take place only as desired, and means for connecting load circuits to be controlled to contacts of other banks of said plurality of banks associated with said third step-by-step switch.

8. Electrical switching apparatus for a robot phonograph or the like, comprising: timed-electrical-impulse-producing-means, step by step switch means having a plurality of wiper contacts, a plurality of sets of stationary contacts, one set for each of said wiper contacts, and an electromagnetic device for advancing said wiper contacts across said stationary contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, connections between the stationary contacts associated with said last two wiper contacts and said timed-electrical-impulse-producing-means for energizing said electromagnetic device and advancing all of said wiper contacts over the corresponding sets of said stationary contacts.

9. Electrical switching apparatus for timed switching or the like, comprising: a device to be controlled, timed-electrical-impulse-producing-means, a step by step switch having a plurality of wiper contacts, a plurality of banks of contacts, one bank for each of said wiper contacts, said wiper contacts and said banks of contacts being movable with respect to each other, and an electromagnetic device for causing relative movement between said wiper contacts and said banks of contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, connections between said banks of contacts associated with said last two wiper contacts and said timed-electrical-impulse-producing-means for energizing said electromagnetic device and causing relative movement between all of said wiper contacts and the corresponding banks of said stationary contacts for controlling actuating circuits of said first mentioned device at predetermined intervals.

10. Electrical switching apparatus for timed switching or the like, comprising: a device to be controlled, timed-electrical-impulse-producing-means, a step by step switch having a plurality of wiper contacts, a plurality of banks of contacts, one bank for each of said wiper contacts, said wiper contacts and said banks of contacts being movable with respect to each other, and an electromagnetic device for causing relative movement between said wiper contacts and said banks of contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, means in said timed-electrical-impulse-producing-means for selecting electrical impulses produced at certain time intervals, connections between said banks of contacts

associated with said last two wiper contacts and said last mentioned means for energizing said electromagnetic device and causing relative movement between all of said wiper contacts and the corresponding banks of said stationary contacts for controlling actuating circuits of said first mentioned device of predetermined intervals.

11. Electrical switching apparatus for timed switching or the like, comprising: a device to be controlled, timed-electrical-impulse-producing-means, a switch having a plurality of wiper contacts, a plurality of sets of stationary contacts, one set for each of said wiper contacts, and an electromagnetic device for advancing said wiper contacts across said stationary contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, means in said timed-electrical-impulse-producing-means for selecting electrical impulses produced at certain time intervals, connections between the stationary contacts associated with said last two wiper contacts and said last mentioned means for energizing said electromagnetic device and advancing all of said wiper contacts over the corresponding sets of said stationary contacts for controlling actuating circuits of said first mentioned device at predetermined intervals.

12. Electrical switching apparatus for timed switching or the like, comprising: a device to be controlled, motor-driven-electrical-impulse-producing-means, a switch having a plurality of wiper contacts, a plurality of sets of stationary contacts, one set for each of said wiper contacts, and an electromagnetic device for advancing said wiper contacts across said stationary contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, means for selecting electrical impulses produced by said first mentioned means, connections between the stationary contacts associated with said last two wiper contacts and said last mentioned means for energizing said electromagnetic device and advancing all of said wiper contacts for controlling actuating circuits of said first mentioned device at predetermined intervals.

13. Electrical switching apparatus for timed switching or the like, comprising: a device to be controlled, motor-driven-electrical-impulse-producing-means, a switch having a plurality of wiper contacts, a plurality of banks of stationary contacts, one bank for each of said wiper contacts, said wiper contacts and said banks of contacts being movable with respect to each other, and an electromagnetic device for causing relative movement between said wiper contacts and said banks of contacts, said electromagnetic device being connected to two of said wiper contacts for energization thereof, means for selecting electrical impulses produced by said first mentioned means, connections between said banks of contacts associated with said last two wiper contacts and said last mentioned means for energizing said electromagnetic device and causing relative movement between all of said wiper contacts and the corresponding banks of said stationary contacts for controlling actuating circuits of said first mentioned device at predetermined intervals.

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