

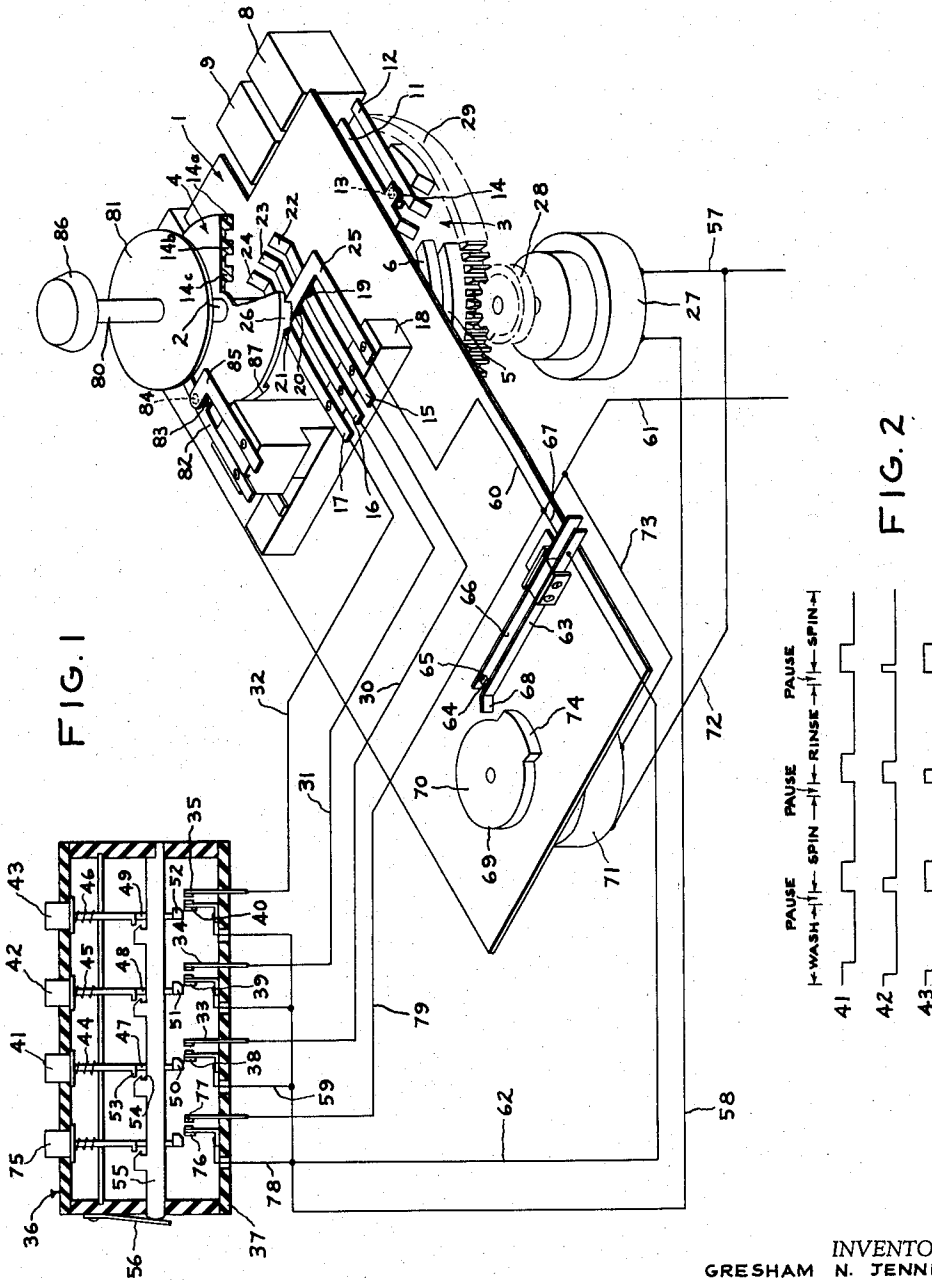
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SEQUENCE CONTROL SYSTEM FOR TIMING MOTOR

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SEQUENCE CONTROL SYSTEM FOR TIMING MOTOR

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This invention relates to control means for apparatus operations and, more particularly, to a control or a timing mechanism which provides for ready selection of any one of a plurality of different sequences of operations.

In certain fields, and particularly in connection with automatic domestic washing machines, it is becoming of importance to be able to select one of a plurality of different sequences of operations. For instance, washing machines normally provide a washing step, a spin step, a rinse step and a second spin step; there may be minor variations, but the basic sequence will normally be followed. In certain types of loads, such as ordinary, color-fast, cotton loads, each of these steps will have a certain optimum length. However, for other types of loads the length of each step will vary, not necessarily proportionately. Thus, for instance, where delicate synthetics are concerned it may be desirable to have all of the operations shortened. For another type of load, such as woolen blankets, it may be desirable to shorten the washing and rinsing time but to have the spin times remain the same or be even longer in order to effect a satisfactory extraction of the liquid from the blanket. While, of course, such different sequences of operations can be provided by individual manual selection of each phase of the operation, it is much more desirable to provide a control of the type wherein a single manipulation by the operator will provide an operation which is appropriate in all its phases for the particular type of load being introduced into the automatic washing machine.

It is, accordingly, an object of this invention to provide an improved control mechanism which will conduct a selected one of a plurality of sequences of operations, including the appropriate length of time for each step of the operation, by a single control manipulation by the operator.

A more specific object of the invention is to achieve the above effect by varying the degree of continuity with which the controlling timer motor is energized. In other words, it is intended to vary the length of any one specific step of an operation by intermittently deenergizing the timer motor once it has brought the operation into that particular step, the length of the intermittent de-energization being selected so as to lengthen the step to the extent desired.

A further object of the invention is to achieve the selected intermittent de-energization of the timer motor by providing two energizing circuits therefor, one of them continuous and the other intermittent. Manually operated means are provided for effecting the desired balance between the circuits for any selected operation.

In carrying out this invention, I provide a timer motor which drives control means for controlling a sequence of steps of an operation in response to energization of the motor. The motor is energized through a first circuit which includes switch means, and the switch means in turn is controlled by auxiliary control means also driven by the timer motor. The auxiliary means opens the switch means at a predetermined point in the operation for a predetermined length of timer motor energization. I further provide a second energizing circuit for the timer motor with appropriate means for intermittently completing the second circuit a predetermined percentage of the time that the switch means is open. When the auxiliary control

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means causes the switch means to open the first energizing circuit for the timer motor, the second energizing circuit effects intermittent energization thereof so that the controls are intermittently advanced until the auxiliary control means either ends the cycle or makes the first energizing circuit effective once again to provide continuous energization of the timer motor.

In this manner, the total time for each step of a given operation may be varied as desired by selecting an appropriate balance between energization of the timer motor by the first continuously energizing circuit and through the second intermittently energizing circuit.

The novel features, which are believed to be characteristic of the invention, are set forth with particularity in the appended claims. My invention, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in conjunction with the accompanying drawing.

In the drawing, FIG. 1 is a view in perspective of my improved control mechanism together with a schematic illustration of the electrical connections which make the control effective; and

FIG. 2 is a chart illustrating the results of making different sequence selections, the chart being in effect a development of the cam surfaces controlling the length of the steps of the operation.

Referring now to FIG. 1 of the drawing, there is shown a timing mechanism or control embodying the invention in one form thereof for use with a domestic clothes washing machine. The mechanism is mounted upon an appropriate framework 1 in which is journaled a shaft 2. A pair of cam members 3 and 4 are secured to the shaft so as to rotate therewith. Cam member 3 has a plurality of cam surfaces such as 5 and 6 provided thereon for controlling the various switching operations required for operation of the apparatus to be controlled (such as, for instance, a washing machine). Thus, cam surfaces 5 and 6 may control, for instance, the operation of switches 8 and 9 which, in turn, control machine components such as a drive motor and water valves (not shown). As shown in connection with cam track 5 and switch 8, the controlling electrical elements normally include switch arms 11 and 12 respectively carrying contacts 13 and 14; contact 14 is moved into and out of engagement with contact 13 by the rises and dwells on the cam track. Other cams and switches are provided as needed to control the other functioning components of the machine.

Cam member 4 has a plurality of cam surfaces 14a, 14b and 14c. A plurality of switch arms 15, 16 and 17, corresponding respectively to the three cam tracks of cam 4, are insulatedly secured to framework 1 by insulating block 18. The contact arms 15, 16 and 17 are respectively provided with contacts 19, 20 and 21, and are formed at their ends into cam followers 22, 23 and 24 controlled respectively by the cam surfaces 14a, 14b, and 14c. The relationship of the cam followers to the cam surfaces is such that when a rise in the cam surface is encountered by a cam follower the corresponding switch contact is disengaged from a conductive member 25; in the dwells of the cam surface, the switch contact is electrically connected with the conductive member 25. Thus, for example, it can be seen that when cam follower 22 is engaged with cam rise 26 the contact 19 of contact arm 15 will become disengaged from conductive member 25.

The rotation of shaft 2 to cause effective movement of the cams to control the operations is provided for by suitable electrically actuated means. In the present instance, a timer motor 27 of the synchronous type operates through a suitable gear train terminating in pinion 28 to drive gear 29 formed by the peripheral surface of the cam member 3.

As will appear more clearly from the description of the

operation, it is desirable that no more than one of the cam tracks 14a, 14b and 14c be effective at once. In order to effect this, the contact arms 15, 16 and 17 respectively controlled thereby are connected through leads 30, 31 and 32 to contacts 33, 34 and 35 respectively. These contacts form part of an assembly, generally indicated at 36, including a frame 37 on which stationary contacts 38, 39 and 40 are mounted to be respectively engageable with contacts 33, 34 and 35. Also mounted on framework 37 are manually operable push-buttons 41, 42 and 43 which are biased to an outward position by the effect of springs 44, 45 and 46 respectively. The three push-buttons 41, 42 and 43 are secured respectively through members 47, 48 and 49 to camming surfaces 50, 51 and 52; when the push-buttons are manually depressed, the camming surfaces 50, 51 and 52 are respectively effective to cause engagement of contacts 38 and 33, 39 and 34, and 40 and 35.

In order to retain the contacts in engagement after pressure on the push-button has ceased, suitable means may be provided; as shown, these may comprise, in connection with push-button 41, a latch projection 53 engageable in a notch 54 formed on a rod 55 which is secured within framework 37 so as to be slidable lengthwise thereof. A spring member 56 biases rod 55 to a position where projection 53 is retained within notch 54 after the push-button 41 has been pushed down against the action of springs 44 and 56. It will thus be seen that once push-button 41 has been depressed contacts 38 and 33 will remain in engagement even after the operator releases the push-button. It will further be observed that closing of contacts 33 and 38 completes a circuit to that point from contact 19 and conductive member 25; since contacts 39 and 34, and 40 and 35 are opened, it then becomes immaterial whether contacts 20 and 21 are in engagement with conductive member 25 or not, i.e., contact 19 is the controlling one of the three. Assuming push-button 41 to have been depressed to cause engagement of contacts 38 and 33, a continuous energizing circuit is then completed for timer motor 27: the timer motor is connected across one side of the source of power (not shown) through conductor 57; the connection across the other side of the source of power is made through conductor 58, conductor 59, contacts 38 and 33, conductor 30, contact arm 15, contact 19, conductive member 25, and conductors 60 and 61. Thus, with contacts 38 and 33 maintained closed as described above, energization of the timer motor 27 is completely dependent upon contact 19 as controlled by cam track 14a.

In similar manner, it will be obvious that if button 42 were depressed to close contacts 39 and 34, instead of button 41 having been depressed, control of the timer motor energization would be effected through contact 20 as controlled by cam track 14b. The same would also be true in the case of button 43, in which case contact 21 and cam track 14c would control the energization of timer motor 27.

There is however, a second circuit through which timer motor 27 can be energized independently of the cam 4. The second circuit, starting with conductor 57, extends through the timer motor 27 and conductor 58 to a conductor 62 leading to a contact arm 63 having a contact 64 intended to engage a contact 65 of a contact arm 66. Contact arm 66 in turn is connected through conductor 67 to conductor 61 to complete the second energizing circuit for timer motor 27. It will be observed that this circuit is dependent upon the connection of contacts 64 and 65 to be effective.

Contact arm 63 terminates in a cam follower portion 68 which is engageable with the surface 69 of a cam member 70. Cam 70 is driven by any suitable electrically actuated means such as, for instance, a timing motor 71 which rotates cam 70 at a suitable speed, for instance, 1 R.P.M. Motor 71 is energized across one side of the power source through conductor 57 and conductor 72, and across the other side of the source through conductor 61

and conductor 73. Cam 70 has a predetermined portion of its surface 69 formed as a rise 74. In the present embodiment, this rise is shown as constituting 72 degrees or $\frac{1}{2}$ of the periphery of the cam, but it will be understood more clearly from the description of the operation of the device that this amount may be varied to a substantial extent. When rise 74 engages cam follower 68, contact 64 is maintained in engagement with contact 65. Otherwise, during the remainder of each rotation of cam 70, switch arm 63 is biased to a position wherein contact 64 is separated from contact 65 thus opening the second circuit to timer motor 27.

When the cam track of cam 4 which has been selected by one of push-buttons 41, 42 and 43 has caused separation of conducting member 25 and the contact controlled by the cam track, timer motor 27 ceases to be energized continuously through the first energizing circuit therefor; thereafter, as long as member 25 and the controlling contact are separated, it is energized only intermittently by the second energizing circuit, with the amount of time of energization of the timer motor relative to total elapsed time being the same as the proportion of the number of degrees in the rise 74 compared to 360 degrees, i.e., one rotation of the cam. To phrase it differently, timer motor 27 has two energizing circuits and the division of control between them is determined by the shape of the selected cam track on cam 4.

It will of course be understood that in the described embodiment cam 70 rotates continuously through an operation but that its intermittent making and breaking action has no effect as long as a circuit is completed to the timer motor through conducting member 25. It will also readily be seen that the continuous operation of cam 70 is primarily a manufacturing expedient; the same effect could readily be obtained by the minor change of placing motor 71 and cam 70 under the control of cam 4 so that they would operate alternatively with completion of a circuit through member 25, i.e. motor 71 would be energized by the cam rises and de-energized by the dwells.

The control system is completed by the provision of an additional push-button 75 which controls the opening and closing of a pair of contacts 76 and 77 in the same manner as described in connection with push-buttons 41, 42 and 43. Contact 76 is joined by a conductor 78 to conductor 58 and contact 77 is joined by conductor 79 to conductor 61. Thus, when push-button 75 is actuated to close contacts 76 and 77, a continuous circuit for timer motor 27 is completed, starting at conductor 57, through the timer motor 27, conductors 58 and 78, contacts 76 and 77, and conductors 79 and 61. This in effect adds another sequence of operations to the selection available, which sequence corresponds exactly to the length of the cams on cam member 3. This results from the fact that the circuit when push-button 75 is actuated by-passes cam member 4 to provide a continuous energizing circuit for timer motor 27; there is then no dependence whatsoever on the second energizing circuit controlled by cam 70. It will, incidentally, be clear that pushing down any one of push-buttons 75, 41, 42 and 43 serves to move rod 55 to the left, as viewed in FIG. 1, to release whichever other push-button was previously held down. Thus, selection of any one of the push-buttons automatically releases the previously selected push-button.

While it forms no part of the present invention, the control apparatus illustrated will generally embody the provision of a tube 80 which is secured to a disc 81 so that both are rotatable with shaft 2 but are slidable thereon. Disc 81 is positioned in controlling relationship with a contact arm 82 which carries a contact 83 intended to engage contact 84 on stationary contact arm 85. Movement of sleeve 80 and disc 81 downwardly as shown in FIG. 1 causes disengagement of contacts 83 and 84. While the connection of contacts 83 and 84 is not illustrated herein, the usual arrangement provides one of the

contacts connected to the source of power directly and the other connected to the source of power in series with all the electrically operating parts of the machine and of the control; thus, the machine controlled by the mechanism of this invention and the control itself may be de-energized by the simple axial movement described. This is provided in case the operator of the machine wishes to repeat or eliminate a portion of any given cycle. In the event that this is intended, it is then simply necessary to grasp the knob 86, push inwardly to disengage the contacts 83 and 84, turn the knob until the desired modification has been provided, and then pull the knob back outwardly to permit re-engagement of contacts 83 and 84. Devices of this type are well known in the art and therefore the specific additional components generally provided, such as a proper indicating dial associated with the knob to show the operation being performed, and suitable clutching means releasing the cams from the motor during the manual modification of the operation, are not shown or described.

Referring now to FIG. 2, the operation of the improved control of this invention, as applied to a typical washing machine cycle, will be described. The typical sequence of steps of washing, spinning, rinsing, and then again spinning, as normally provided by washing machines, has been selected for illustrative purposes. Also for illustrative purposes, the time provided for each of these steps when the timer motor 27 is continuously energized has been shown as three minutes, with an appropriate pause between each two steps to permit operation of the switches by the cams. Assuming that a washing cycle of the type provided by pushbutton 41 (appropriate, for instance, for color-fast cottons) is desired, button 41 is depressed to close contacts 33 and 38 and to release whichever other contacts may have been previously closed. This then makes engagement of contact 19 with conducting member 25 effective to control the first energizing circuit for timer 27.

After the filling of the washing machine has been effected by any means well known in the art, timer 27 starts to time the washing step of the operation; if the timer runs continuously, this step will last for a total of three minutes as determined by the contour of the appropriate cams provided on cam member 3. However, rotation of cam member 4 causes rise 26 to engage the cam follower 22. This forces contact 19 out of engagement with conductor member 25, as shown by the first rise on the line 41 in FIG. 2. This rise is approximately equal to 50 seconds of continuous timer energization. However, because of cam 70, the timer is energized only $\frac{1}{5}$ of the time when contact 19 is separated from conductor member 25. Therefore, the timer 27 is energized only 12 seconds out of each minute which actually elapses so that a total of just over 4 minutes is necessary to cause the timer motor 27 to be energized long enough to move cam 4 sufficiently for follower 22 to get beyond rise 26 to a dwell portion of cam tracks 14a. At this point, contact 19 re-engages conductor member 25 and the timer motor is energized continuously for the remainder of the wash step. Inasmuch as a total of 3 minutes is provided for washing under continuous timer energization, and since 50 seconds of this has been taken up by the intermittent energization of timer motor 27, 2 minutes and 10 seconds of washing time remain before the washing step is finished, as controlled by the cams on cam member 3. 4 minutes and 2 seconds (provided by timer motor 27 under the intermittent energization of its second circuit) plus 2 minutes and 10 seconds (provided by the timer motor under the continuous energization of its first circuit) provide a total of 6 minutes and 12 seconds of washing.

The timer motor remains continuously energized through the remainder of the washing step and through the pause which follows. When the spin step starts, the second rise 87 opens contact 19 and conductor mem-

ber 25 and again places the timer motor under the control of cam 70 so that intermittent energization is provided. Thus, in the same manner, the spin portion of the sequence may be caused to last an appropriate length of time, in this case shown as the same length of time as the washing operation. At the end of the 50 seconds of "energized-timer" time, or 4 minutes and 2 seconds of actually elapsed time, the cam 4 is moved sufficiently far for follower 22 to be beyond rise 87; contact 19 closes with conductive member 25, and the timer is continuously energized again for the remainder of the spin step and the pause which follows. In a similar manner, the rinse step and the final spin step may also be lengthened.

Depression of pushbutton 42 may be provided in the event that the load to be washed is, for instance, fine synthetic wearing apparel. In such a case, the steps are normally intended to be shorter to varying degrees than when cottons are washed, and this is achieved, as shown, by decreasing the amount of time that the cam member 4 causes the continuously energizing circuit to be opened.

By depression of pushbutton 43 yet a different cycle may be provided by using the third cam track 14c. This may be, for instance, intended primarily for special loads such as blankets where the washing and rinsing steps should be relatively short because the fabric is of a delicate nature, but the spin operations should be relatively long because of the substantial tendency of the fabric to retain liquid.

There may also be instances where the cycle provided by the cams or cam 3 may be satisfactory without any modification whatsoever as to time. In such a case, depression of pushbutton 75 closes a continuously energizing circuit for motor 27 which bypasses completely any control by cam 4.

It will be seen from the foregoing that the present control, when used in a washing machine, tailors by a single control manipulation the time of each of the different steps of a washing operation to the type of load being washed.

In accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention, but it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the invention, and I therefore aim to cover in the appended claims all such equivalent variations and modifications.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A control device comprising electrically actuated means, control means driven by said electrically actuated means for controlling the sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means towards said second position, a first energizing circuit for said electrically actuated means, switch means in said first energizing circuit, said control means including cam means having a portion arranged to open said switch means at a predetermined position in said operation, a second energizing circuit for said electrically actuated means, and means intermittently completing said second circuit a predetermined percentage of the time said switch means is open, whereby said electrically actuated means is intermittently energized through said second circuit until said cam means portion has been driven past its switch means opening position.

2. A control device comprising electrically actuated means, control means driven by said electrically actuated means for controlling the sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means

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causing movement of said control means towards said second position, first and second energizing circuits for said electrically actuated means, said control means including means for completing said first energizing circuit for at least one predetermined portion of said operation and for opening said first energizing circuit for at least one other predetermined portion of said operation, and means intermittently completing said second energizing circuit a predetermined percentage of the time when said first energizing circuit is open, whereby said electrically actuated means is continuously energized when said first energizing circuit is completed and is intermittently energized through said second energizing circuit when said first energizing circuit is open.

3. A control device comprising electrically actuated means, control means driven by said electrically actuated means for controlling the sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means towards said second position, a first energizing circuit for said electrically actuated means, switch means in said energizing circuit, said control means including cam means driven by said electrically actuated means comprising a plurality of cam tracks, each of said cam tracks having at least one portion arranged to open said switch means during said operation, said cam tracks being formed differently from each other so as to provide differences in the duration of the opening of said switch means, a second energizing circuit for said electrically actuated means, means intermittently completing said second circuit a predetermined percentage of the time when said first energizing circuit is open whereby said electrically actuated means is intermittently energized through said second circuit whenever said one of said cam tracks causes said first energizing circuit to be opened, and manual means for selecting one of said cam tracks to control completion of said first energizing circuit.

4. A control device comprising electrically actuated means including a timer motor and an output shaft driven thereby, main cam means secured on said shaft to rotate therewith, follower means engaging said main cam means for controlling the steps of an operation, said main cam means in a first position commencing said operation and in a second position terminating said operation, energization of said timer motor causing movement of said main cam means towards said second position, a first energizing circuit for said timer motor, switch means in said first energizing circuit, auxiliary cam means secured on said shaft to rotate therewith and having a portion arranged to open said switch means at a predetermined position in said operation, a second energizing circuit for said timer motor, and means intermittently completing said second circuit a predetermined percentage of the time throughout the controlled operation, whereby said timer motor is intermittently energized through said second circuit until said auxiliary cam means has rotated past its switch opening position.

5. A control device comprising electrically actuated means, control means driven by said electrically actuated means for controlling a sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means towards said second position, a first energizing circuit for said electrically actuated means, switch means in said first energizing circuit, a plurality of cams driven by said electrically actuated means each having at least one portion arranged to open said switch means, said portions being differently arranged on said different cams so as to provide different durations of opening of said switch means, a second energizing circuit for said electrically actuated means, means intermittently completing said second circuit a predetermined percentage of the time when said first energizing circuit is

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open whereby said electrically actuated means is intermittently energized through said second circuit whenever said switch means is opened by one of said cams, and a plurality of manually operable members respectively associated with said cams, said manually operable members being arranged to make their associated cams normally ineffective to control completion of said first circuit and being arranged so that manual operation of a selected one of said manually operable members causes the one of said cams associated therewith to control said first energizing circuit through said switch means.

6. The apparatus defined in claim 5 including an additional manually operable member, a third circuit for energizing said electrically actuated means, said third circuit being independent of said cams and of said intermittent circuit completing means, and switch means for completing said third circuit and operated by said additional member whereby selection of said additional member causes continuous energization of said electrically actuated means throughout said operation.

7. A control device comprising electrically actuated means, first control means driven by said electrically actuated means for controlling the sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means towards said second position, first and second energizing circuits for said electrically actuated means, said control means including auxiliary control means driven by said electrically actuated means for completing said first energizing circuit for at least one predetermined portion of said operation, and for opening said first energizing circuit for at least one other predetermined portion of said operation, and means intermittently completing said second energizing circuit a predetermined percentage of the time when said first energizing circuit is opened, whereby said electrically actuated means is continuously energized when said first energizing circuit is completed and is intermittently energized through said second energizing circuit when said first energizing circuit is open.

8. A control device comprising electrically actuated means, control means driven by said electrically actuated means for controlling the sequence of steps of an operation, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means toward said second position, a first energizing circuit for said electrically actuated means, switch means in said first energizing circuit, said control means including first cam means having a portion arranged to open said switch means at a predetermined position in said operation, a second energizing circuit for said electrically actuated means, and means intermittently completing said second circuit a predetermined percentage of the time said switch means is open comprising switch means in said second circuit, second cam means including a portion of cam surface arranged to close said second circuit switch means and a portion of cam surface arranged to open said second circuit switch means, and means for driving said second cam means so that said second cam means portions alternately open and close said second circuit switch means when said first circuit switch means is opened, whereby said electrically actuated means is intermittently energized through said second circuit until said first cam means portion has been driven past its first switch means opening position.

9. The apparatus defined in claim 8 wherein said means for driving said second cam means operates throughout the controlled operation, said second switch means being without effect on said electrically actuated means during the periods when said first circuit switch means is closed.

10. A control device comprising electrically actuated means, control means driven by said electrically actuated

means for controlling the sequence of steps of an operation, said control means comprising a plurality of cam surfaces driven by said electrically actuated means, a plurality of cam followers respectively controlled by said cam surfaces, and a plurality of switch means respectively controlled by said cam followers, said control means in a first position commencing said operation and in a second position terminating said operation, energization of said electrically actuated means causing movement of said control means toward said second position, a first energizing circuit for said electrically actuated means, switch means in said first energizing circuit, said control means including cam means having a portion arranged to open said switch means in a predetermined position in said operation, a second energizing circuit for said elec-

trically actuated means, and means intermittently completing said second circuit a predetermined percentage of the time said switch means is open, whereby said electrically actuated means is intermittently energized through said second circuit until said cam means portion has been driven past its switch means opening position.

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