

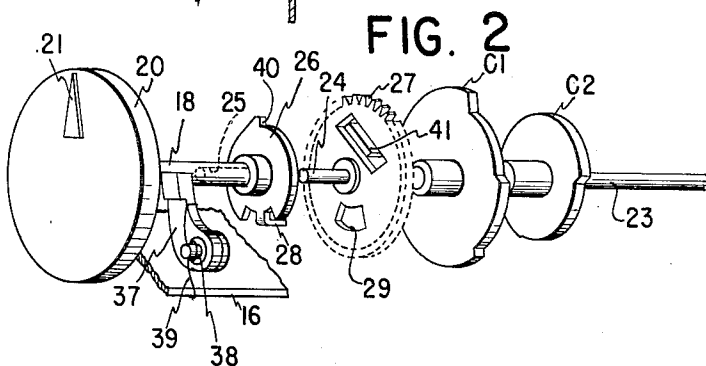
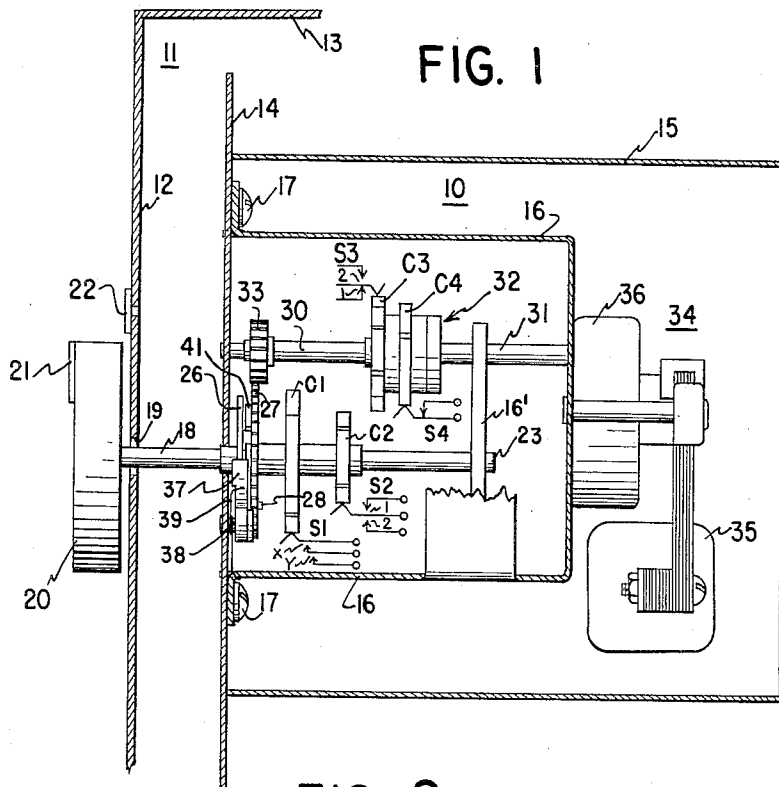
Jan. 2, 1951

R. L. BERG
PROGRAM SELECTOR SWITCH

2,536,256

Filed Nov. 22, 1949

3 Sheets-Sheet 1



INVENTOR.
Ralph L. Berg

 BY

Smith, Olsen & Baird
Attys.

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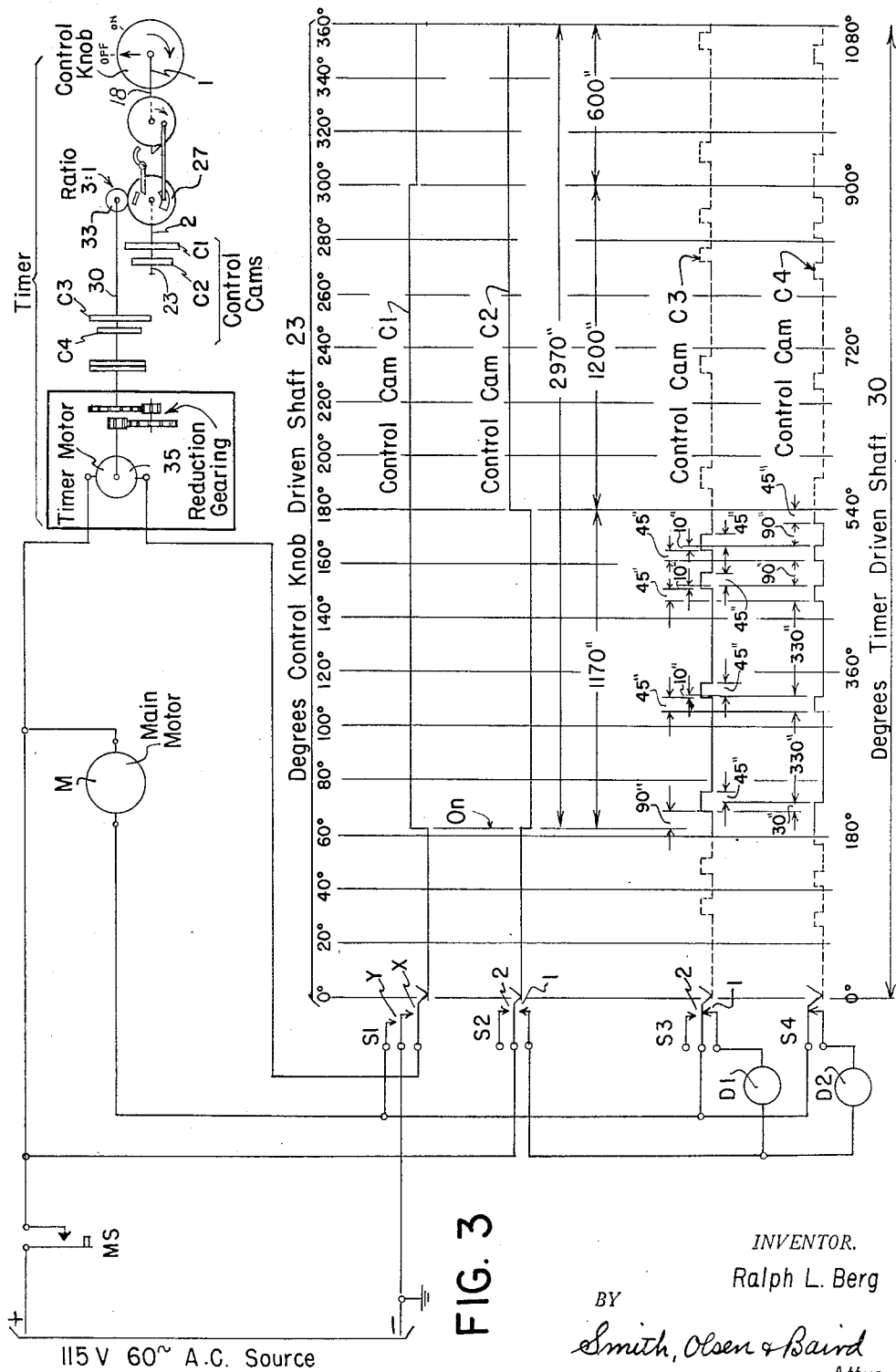
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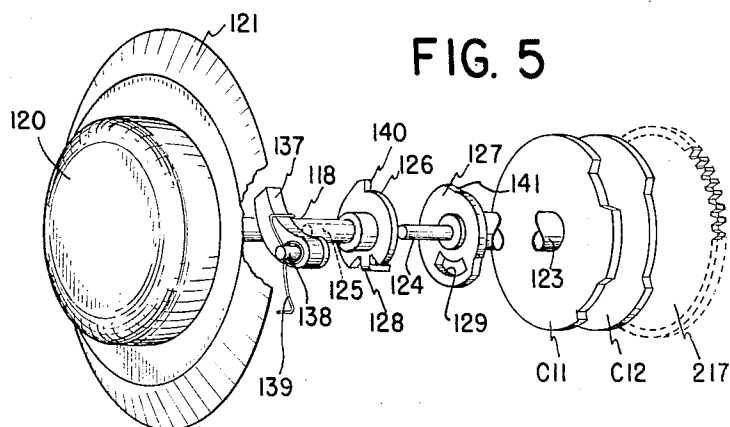
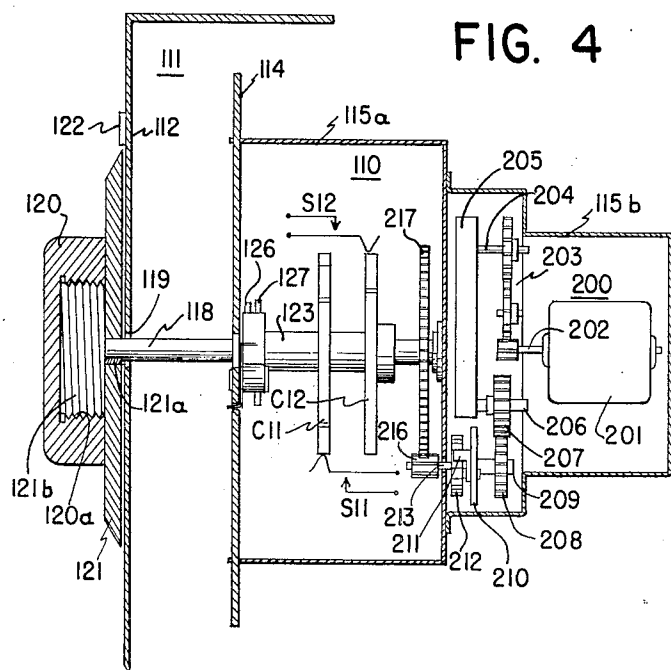
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3 Sheets-Sheet 3



INVENTOR.

Ralph L. Berg

 BY

Smith, Olsen & Baird

Attys.

UNITED STATES PATENT OFFICE

2,536,256

PROGRAM SELECTOR SWITCH

Ralph L. Berg, Chicago, Ill., assignor to Hotpoint Inc., a corporation of New York

Application November 22, 1949, Serial No. 128,869

11 Claims. (Cl. 161—1)

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The present invention relates to program selectors, and more particularly to improved program selector switches of the character of that disclosed in the copending application of Douglas F. Illian, Serial No. 91,906, filed May 7, 1949.

The program selector switch disclosed in the Illian application mentioned is especially suitable for use in controlling the automatic cycle of such home appliances as dishwashing apparatus, clothes washing machines, and the like. This switch essentially comprises a rotatable operating shaft having an "off" position and a plurality of "control" positions and rotatable continuously in a given direction from its "off" position into its first "control" position, thence into its second "control" position, etc., and ultimately back into its "off" position. A manually operable control dial or knob is carried on the outer end of the operating shaft to provide for rotation thereof, and a number of insulating control cams are secured to the inner end of the operating shaft and cooperate with corresponding sets of switch springs. The sets of switch springs are selectively operated between open and closed circuit positions by the selective rotation of the control cams, and are included in the various operating circuits of the associated appliance so that the appliance may be operated through a predetermined operating cycle. Also, the switch comprises an electric timer motor arrangement operatively connected to the operating shaft for rotating it at a predetermined rate in the given direction, a slip clutch being included in this arrangement so that rotation of the operating shaft by the manually operable control dial does not interfere with the operation of the timer motor. One of the operating circuits of the appliance comprises the electric timer motor and this circuit is controlled by the associated set of switch springs so that it is completed in response to rotation of the operating shaft away from its "off" position into any one of its "control" positions and so that it is interrupted in response to the rotation of the operating shaft back into its "off" position.

In view of the foregoing description of the construction and arrangement of this program selector switch and the connection thereof in the associated appliance, it will be appreciated that in response to manual rotation of the operating shaft from its "off" position into its first "control" position, an automatic timed operation thereof is initiated so that the predetermined cycle of operation of the appliance is carried out on a timed basis, and ultimately rotation of the operating shaft is arrested in response to the

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return thereof into its "off" position. This arrangement permits the user of the appliance selectively to omit or skip any one or more of the phases in the operating cycle of the appliance and selectively to repeat any one or more of the phases in the operating cycle of the appliance by the appropriate manipulations of the manually operable control dial.

While these selective operations of this program selector switch are very advantageous in that they lend maximum flexibility to the control of the associated appliance, this very flexibility may result in improper operation of the appliance unless some care is exercised by the user in the manipulation of the manually operable control dial. Specifically, the user may seize the control dial and rotate it hurriedly in the given direction from its "off" position through its first "control" position into its second, etc., "control" position and then release the control dial in order that automatic timed operation of the program selector switch may take place. In this case operation of the associated appliance is initiated in the second, etc., phase of its operating cycle, the first, etc., phase thereof having been skipped or omitted due to the careless initial manipulation of the control dial by the user. In some appliances this skipping of the first phase of the operating cycle thereof may be of little consequence, but in other appliances, such, for example, as dishwashing apparatus, and the like, the skipping of the first phase of the operating cycle thereof renders the performance of the remainder of the phases of the operating cycle thereof virtually useless, whereby the appliance fails to perform its intended function or operation. This characteristic of this program selector switch may prove to be annoying to the user of an appliance as the difference between satisfactory and unsatisfactory operations of the appliance depends upon the small angle of rotation of the operating shaft in the program selector switch between its first and second "control" positions, and the user must sense the first "control" position of the operating shaft in the switch by the feel thereof during the initial manipulation of the manually operable control dial.

Accordingly, it is a general object of the present invention to provide in a multiposition program selector switch of the combination manually and automatically operated type, an arrangement for preventing inadvertent manual operation thereof through a given one of its "control" positions and for accommodating contemplated manual opera-

tion thereof through other ones of its "control" positions.

Another object of the invention is to provide in a program selector switch of the character described, an arrangement responsive to rotation of the operating shaft by the manually operable control dial from its "off" position into its first "control" position for disabling the manually operable control dial and responsive to rotation of the operating shaft by the electric timer motor through a given angle from its first "control" position, for again enabling the manually operable control dial, whereby inadvertent skipping of the first control phase of the switch by the user is avoided while preserving to the user the facility of contemplated skipping of subsequent control phases of the switch.

A further object of the invention is to provide in a program selector switch of the character described, an improved stop mechanism that is selectively operative to block and to unblock rotation of the manually operable control dial and that is selectively governed jointly by manual operation of the manually operable control dial and by automatic operation of the associated timer.

Further features of the invention pertain to the particular arrangement of the elements of the program selector switch, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 is a longitudinal sectional view of a program selector switch embodying the present invention; Fig. 2 is a fragmentary exploded perspective view of the principal operating mechanism of the switch shown in Fig. 1; Fig. 3 is a partial electric diagram of the circuit control arrangement of an appliance in which the switch of Fig. 1 is incorporated; Fig. 4 is a longitudinal sectional view of a modified form of the program selector switch embodying the present invention; and Fig. 5 is a fragmentary exploded perspective view of the principal operating mechanism of the switch shown in Fig. 4.

Referring now to Figs. 1 and 2 of the drawings, there is illustrated a program selector switch 10 of the character of that disclosed in the previously mentioned Illian application and embodying the features of the present invention. The switch 10 is incorporated in an appliance 11, the front and top walls of which are indicated generally at 12 and 13, the switch 10 being suitably supported upon the structure, not shown, of the appliance 11. The switch 10 is of the combination manually and timer controlled type and comprises a front plate 14 having a casing 15 detachably secured thereto and carrying a supporting bracket 16 within the casing 15, the bracket 16 being secured to the plate 14 by a pair of screws 17. A first rotatable operating shaft 18 is suitably journaled in an opening provided in the plate 14 and projects forwardly through a hole 19 provided in the front wall 12 to the exterior of the appliance 11. A manually operable control dial or knob 20 is rigidly secured to the extreme outer end of the shaft 18 and carries a pointer 21 that cooperates with an index member 22 suitably secured to the front wall 12. A second rotatable operating shaft 23 is suitably

journaled in an opening provided in the bracket 16 and projects forwardly toward the inner end of the shaft 18, the shafts 18 and 23 being arranged in axial alignment. More particularly, the outer end of the shaft 23 carries a forwardly projecting pin or bearing portion 24 that is received in a cooperating cylindrical bearing opening 25 formed in the inner end of the shaft 18, whereby the outer end of the shaft 24 and the inner end of the shaft 18 mutually support each other and are rotatable with respect to each other due to the bearing connection 24-25.

A lost-motion drive connection is provided between the shafts 18 and 23 by an arrangement including a cam 26 rigidly secured to the inner end of the shaft 18 and a gear 27 rigidly secured to the outer end of the shaft 23. More particularly, the cam 26 is provided with a rearwardly extending finger 28 that projects into an arcuate shaped slot or opening 29 formed in the gear 27, the arcuate width of the finger 28 being somewhat less than the arcuate width of the slot 29 so that the shaft 18 must be rotated through a small angle in order to cause the opposite sides of the finger 28 to engage the opposite ends of the slot 29 to provide the lost-motion mentioned.

Also the switch 10 comprises a third rotatable operating shaft 30 and a stub shaft 31 arranged substantially in alignment with respect to each other and disposed above the shafts 18 and 23. The outer end of the shaft 30 is suitably journaled in an opening provided in the plate 14 and the inner end of the stub shaft 31 is suitably journaled in an opening provided in the bracket 16, the inner end of the shaft 30 and the outer end of the shaft 31 terminating in a friction clutch 32. The details of the friction clutch 32 are not illustrated, but the adjacent face plates thereof are urged into frictional engagement with each other and are respectively rigidly secured to the shafts 30 and 31 for a purpose more fully explained hereinafter. The shafts 23 and 30 are interconnected by a speed-change gearing arrangement including the gear 27 rigidly secured to the shaft 23 and a pinion 33 rigidly secured to the shaft 30. The gear 27 secured to the shaft 23 has precisely N times as many teeth as the pinion 33 secured to the shaft 30, where N is equal to 3. Accordingly, the gearing noted effects a 1:3 speed ratio between the shafts 23 and 30; whereby one revolution of the shaft 23 effects three revolutions of the shaft 30 and one revolution of the shaft 30 effects $\frac{1}{3}$ revolution of the shaft 23. Further, the switch 10 comprises a timer motor unit 34 of the electro-responsive type that is also carried by the bracket 16. The timer motor unit 34 may be of the "Telechron" type including an electric motor proper 35 and a gear box 36 housing the usual speed reduction gearing, the speed reduction gearing housed within the gear box 36 interconnecting the stub shaft 31 and the rotor of the motor proper 35. The gearing within the gear box 36 is so constructed and arranged that when the motor proper 35 is energized from a 115 volts 60 cycle A. C. source the stub shaft 31 is rotated in the counterclockwise direction, as viewed from the front of the switch 10, at a speed of precisely three revolutions per hour.

Further, the switch 10 comprises stop mechanism that is selectively operative to block and to unblock rotation of the manually rotatable shaft 18 and including a pawl 37 pivotally mounted upon a rearwardly projecting pin 38 carried by the plate 14, the pawl 37 being biased in

the counterclockwise direction, as viewed from the front of the switch 10, about the pin 38 by a coil spring 39. The coil spring 39 surrounds the pin 38 and is disposed between the plate 14 and the pawl 37, one end of the coil spring 39 engaging the bracket 16 and the other end of the coil spring 39 engaging the pawl 37. The outer operating end of the pawl 37 rides the peripheral surface of the cam 26 and cooperates with an outwardly projecting shoulder 40 disposed thereon. Also, the outer operating end of the pawl 37 is disposed closely adjacent to the outer face of the gear 27 and cooperates with a forwardly projecting tongue 41 struck therefrom.

Further, the switch 10 comprises two spaced-apart insulating control cams C1 and C2 rigidly secured to the shaft 23 and two insulating control cams C3 and C4 rigidly secured to the shaft 30. Four sets of switch springs S1, S2, S3 and S4 are respectively operatively associated with the four control cams C1, C2, C3 and C4 and are respectively operated thereby into various circuit controlling positions. Specifically, the set of switch springs S1 comprises three individual springs, the uppermost of which rides upon the periphery of the control cam C1; and the periphery of the control cam C1 is so constructed and arranged that it may selectively move the uppermost switch spring selectively to open and to close the contacts X between the uppermost switch spring and the intermediate switch spring and that it may selectively move the intermediate switch spring to open and to close the contacts Y between the intermediate switch spring and the lowermost switch spring. The set of switch springs S2 comprises three individual springs, the intermediate of which rides upon the periphery of the control cam C2; and the periphery of the control cam C2 is so constructed and arranged that it may selectively move the intermediate switch spring selectively to open both of the contacts 1 and 2 between the intermediate switch spring and the respective upper and lower switch springs or to close either of the contacts 1 and 2. The set of switch springs S3 comprises three individual springs, the intermediate of which rides upon the periphery of the control cam C3; and the periphery of the control cam C3 is so constructed and arranged that it may selectively move the intermediate switch spring selectively to open or to close either of the contacts 1 and 2 between the intermediate switch spring and the respective upper and lower switch springs. The set of switch springs S4 comprises two individual springs, the lower of which rides upon the periphery of the control cam C4; and the periphery of the control cam C4 is so constructed and arranged that it may selectively move the lower switch spring selectively to open and to close the associated contacts between the lower switch spring and the upper switch spring.

The manually rotatable shaft 18 is journaled for rotation in either direction but is normally rotated only in the clockwise direction, as viewed from the front of the switch 10, and comprises an "off" position and an "on" position. The pointer 21 carried on the control dial 20 respectively registers with the legends "off" and "on" carried upon the index member 22 when the shaft 18 is rotated into its respective "off" and "on" positions. The operating shaft 23 comprises an "off" position and a plurality of "control" positions. The "off" positions of the shafts 18 and 23 are coordinate; and the "on" position of the

shaft 18 is coordinate with the first "control" position of the shaft 23. Moreover, the cam 26 is rigidly secured to the inner end of the shaft 18 in a predetermined position so that when the shaft 18 is rotated in the clockwise direction by the manual control dial 20 from its "off" position into its "on" position, the operating end of the pawl 37 engages the shoulder 40 provided on the cam 26 preventing further rotation of the shaft 18 by the manual control dial 20. Further, as the shaft 18 is rotated from its "off" position into its "on" position the finger 28 provided on the cam 26 moves in the slot 29 provided in the gear 27 taking up the lost-motion previously mentioned and then engages the end of the slot 29 rotating the shaft 23 from its "off" position into its first "control" position. As the shaft 23 is rotated in the clockwise direction the gear 27 rigidly secured thereto drives the meshing pinion 33, whereby the operating shaft 30 is rotated in the counterclockwise direction, the friction clutch 32 accommodating rotation of the shaft 30 in the counterclockwise direction with respect to the stub shaft 31 so that there is no interference with the timer motor unit 34.

Considering now the operation of the switch 10 in greater detail and in conjunction with Fig. 3, when the shaft 18 is rotated in the clockwise direction from its "off" position into its "on" position by the manual control dial 20, the shaft 23 is rotated from its "off" position into its first "control" position as previously noted, whereby the control cam C1 operates the set of switch springs S1 to close the X and Y contacts thereof. When the X contacts of the switch S1 are thus closed, a circuit, traced hereinafter, is completed for energizing the electric timer motor 35, whereby the electric timer motor 35 drives the stub shaft 31 in the counterclockwise direction through the gearing in the gear box 33; and the stub shaft 31 drives the shaft 30 in the counterclockwise direction through the friction clutch 32. Rotation of the shaft 30 in the counterclockwise direction drives the shaft 23 in the clockwise direction through the gearing, including the pinion 33 and the gear 27. As the gear 27 is thus driven in the clockwise direction, the slot 29 formed therein moves with respect to the finger 28 carried by the cam 26 that is rigidly secured to the shaft 18, whereby the shaft 23 is rotated through a small given angle in the clockwise direction independently of the shaft 18 and corresponding to the lost-motion between the finger 28 and the slot 29. As the gear 27 is thus rotated in the clockwise direction through the small given angle mentioned the tongue 41 struck therefrom engages the operating end of the pawl 37 rotating the pawl 37 in the clockwise direction about the pin 38 and against the bias of the coil spring 39, whereby the operating end of the pawl 37 disengages the shoulder 40 provided on the cam 26. At this time when the lost-motion has been taken up between the finger 28 and the slot 29, the pawl 37 has been removed from engagement with the shoulder 40, whereby continued rotation of the shaft 23 in the clockwise direction effects additional rotation of the shaft 18 in the clockwise direction due to the engagement between the slot 29 and the finger 28.

Accordingly, it will be understood that when the operating shaft 18 is rotated in the clockwise direction through a predetermined angle from its "off" position into its "on" position by the manual control dial 20 that the pawl 37 operates to block further rotation of the shaft 18 by the

manual control dial 20, and the shaft 23 is rotated in the clockwise direction through a lesser angle from its "off" position into its first "control" position. In its first "control" position the shaft 23 causes the control cam C1 to govern the set of switch springs S1 in order to initiate operation of the electric motor 35, whereby the shaft 23 is rotated further in the clockwise direction through the gearing 33—27, the shaft 30, the clutch 32 and the stub 31 by the timer motor unit 34. When the shaft 23 is rotated further in the clockwise direction from its first "control" position through a given angle therefrom, the tongue 41 operates the pawl 37 to unblock further rotation of the shaft 18, whereby continued rotation of the shaft 23 in the clockwise direction effects further rotation of the shaft 18 in the clockwise direction. In the arrangement, the sum of the lesser angle and the given angle of rotation of the shaft 23 is substantially equal to the predetermined angle of rotation of the shaft 18. In other words, the original lost-motion between the cam 26 and the gear 27 is taken up by the gear 27 to initiate further rotation of the cam 26 just as the pawl 37 is operated from its blocking position into its unblocking position.

As the timer motor unit 34 continues to operate, the shaft 23 is rotated further in the clockwise direction through its second, third, etc., "control" positions and the shaft 18 and the manual control dial 20 is rotated therewith. Ultimately, after a considerable time interval the timer motor unit 34 effects rotation of the shaft 23 the remainder of a complete revolution, whereby the shafts 23 and 18 are again returned to their "off" positions, the pointer 21 carried by the manual control dial 20 again registering the legend "off" carried by the index member 22 at this time. When the shaft 23 is thus returned in the clockwise direction back into its "off" position the set of switch springs S1 are again operated by the control cam C1 in order to open the contacts X and Y thereof, whereby the circuit for energizing the electric motor 35 is interrupted arresting further operation thereof.

Considering now in greater detail the electric control circuit that may be incorporated in the appliance 11, as illustrated in Fig. 3, the arrangement may comprise two power conductors respectively marked "+" and "-" that are connected to a 115 volts 60 cycle A. C. source of current supply, the "-" conductor being grounded in the appliance 11. Further, the appliance may comprise a master switch MS arranged in the "+" conductor and a main operating motor M, as well as two devices D1 and D2. The operating circuit for the main motor M extends directly from one terminal of the master switch MS to the uppermost spring of the set of switch springs S1; the operating circuit for the device D1 extends from one terminal of the master switch MS via the intermediate and lowermost springs of the set of switch springs S2, the intermediate and lowermost springs of the set of switch springs S3 and the intermediate and uppermost springs of the set of switch springs S1 to the "-" conductor; and the operating circuit for the device D2 extends from one terminal of the master switch MS via the intermediate and lowermost springs of the set of switch springs S2, the pair of springs of the set of switch springs S4, and the intermediate and uppermost springs of the set of switch springs S1 to the "-" conductor.

As clearly illustrated in the chart of Fig. 3, when the operating shaft 23 is rotated from its

"off" position into its first "control" position, approximately 62°, the control cam C1 operates the set of switch springs S1 to close both the X and Y contacts thereof, whereby operation of the timer motor 35 is initiated, as previously explained, and operation of the main motor M is also initiated. Also, at this time, the control cam C2 operates the set of switch springs S2 to close the contacts 1 thereof in order to effect operation of both of the devices D1 and D2. As the operating shaft 23 is subsequently rotated in the clockwise direction through its various "control" positions the control cams C3 and C4 respectively operate the sets of switch springs S3 and S4, whereby the devices D1 and D2 are selectively controlled.

When the operating shaft 23 is rotated in the clockwise direction into a predetermined one of its "control" positions, the 180° position, the control cam C2 operates the set of switch springs S2 to open the contacts 1 thereof in order to preclude further selective operations of the devices D1 and D2 under the respective controls of the sets of switch springs S3 and S4. Subsequently, when the control shaft 23 is rotated in the clockwise direction into a further of its "control" positions, the 300° position, the control cam C1 operates the set of switch springs S1 to open the contacts Y without opening the contacts X thereof; whereby, operation of the main motor M is arrested while operation of the timer motor 35 is continued. Ultimately, when the operating shaft 23 is rotated in the clockwise direction back into its "off" position, the 360° or 0° position, the control cam C1 operates the set of switch springs S1 to open the contacts X thereof in order to arrest further operation of the timer motor 35, as previously noted. At this time the cycle of operation of the appliance 11 has been completed and all of the electric circuits are open.

The above-described cooperation between the set of switch springs S2 and S3 jointly to control the device D1, and the cooperation between the sets of switch springs S2 and S4 jointly to control the device D2, are very advantageous in view of the fact that the sets of switch springs S3 and S4 are rendered operative actually to control the devices D1 and D2, respectively, by the set of switch springs S2 only in the segment of the control cam C2 carried by the operating shaft 23 through the arc between 62° and 180° thereof, notwithstanding the rotation of the control cams C3 and C4 carried by the operating shaft 30 through an arc of 1080°. Accordingly, the fine control of the control cams C3 and C4 may be employed during only one revolution thereof, notwithstanding the circumstance that the control cams C3 and C4 are actually rotated three revolutions during one revolution of the control cam C2.

In view of the foregoing description, it will be understood that the user of the appliance 11, upon seizing the manually rotatable control dial 20, may not hurriedly rotate the control dial 20 in the clockwise direction from its "off" position beyond its "on" position due to the operation of the pawl 37 into its blocking position; whereby, the shaft 23 is operated from its "off" position into its first "control" position. However, after a short time interval rotation of the gear 27 by the shaft 23 operates the pawl 37 to its unblocking position, whereby the user of the appliance 11 may then rotate the manual control dial 20 further in the clockwise direction in order to bring about skipping or omission of the corresponding phases,

beyond the first phase, of the cycle of operation of the switch 10, and, consequently, of the appliance 11. Thus, it will be appreciated that while inadvertent skipping or omission of the first phase in the cycle of operation of the switch 10 is prevented, contemplated skipping or omitting of subsequent phases in the cycle of operation of the switch 10 is permitted; all due to the selective operation of the pawl 37 between its blocking and unblocking positions, as previously explained. This arrangement preventing the inadvertent skipping of the first phase in the cycle of operation of the switch 10 is very advantageous as it positively prevents inadvertent improper operation of the appliance 11; while this arrangement permitting the contemplated skipping of the subsequent phases in the cycle of operation in the switch 10 lends flexibility to the control of the appliance 11 so that a particular phase or phases in the cycle of operation of the appliance 11 may be selectively omitted or repeated.

In passing it is noted that in the construction of the switch 10 the manual control dial 20 is always selectively rotatable in the counterclockwise direction since the pawl 37 is selectively operative only to block the rotation of the shaft 18 in the clockwise direction. Accordingly, the user of the appliance 11 may always select a predetermined phase in the cycle of operation of the switch 10 by rotating the manual control dial 20 in the counterclockwise direction in order to set the operating shaft 23 in the corresponding one of its "control" positions. When the shaft 23 is rotated in the counterclockwise direction the shaft 30 is rotated in the clockwise direction independently of the stub shaft 31 due to the arrangement of the friction clutch 32. In this case, operation of the timer motor unit 34 is initiated, whereby the shaft 30 is rotated in the counterclockwise direction and the shaft 23 is rotated in the clockwise direction; all in the manner previously described.

Referring now to Figs. 4 and 5 of the drawings, there is illustrated a modified form of the program selector switch 110 embodying the features of the present invention and incorporated in the associated appliance 111. The switch 110 is of the combined manual and timer controlled type and comprises a front plate 114, a main casing 115a suitably detachably secured to the plate 114 and an auxiliary casing 115b suitably secured to the main casing 115a. In this construction the switch 110 comprises the first and second operating shafts 118 and 123 arranged in axial alignment, the inner end of the shaft 118 being journaled for rotation in an opening provided in the plate 114 and projecting through an aligned hole 119 formed in the front wall 112 of the appliance 111, and the inner end of the shaft 123 being journaled for rotation upon the rear of the main casing 115a. In this arrangement, the outer end of the shaft 123 carries the cylindrical bearing pin 124 that projects into the cylindrical bearing opening 125 provided in the inner end of the shaft 118 so that the shafts 118 and 123 may be rotated through a small angle with respect to each other. In this case, the cam 126 is rigidly secured to the inner end of the shaft 118 and provided with the finger 128 that cooperates with the slot 129 provided in the element 127 to effect the lost-motion connection between the cam 126 and the element 127 for the purpose previously explained in conjunction with the construction of the switch 10. In this embodiment of the switch 110 the element 127 does not comprise a gear and the peripheral

surface thereof is provided with the cam portion 141 corresponding to the tongue 41, provided on the outer face of the gear 27 in the switch 10. This embodiment of the switch 110 further comprises the pawl 137 that is pivotally mounted upon the pin 138 that is carried by the plate 114 and the cooperating coil spring 139 for biasing the pawl 137 in the counterclockwise direction about the pin 138.

In the switch 110 a dial 121 is rigidly secured to the extreme outer end of the shaft 113 employing a key 121a, the dial 121 being disposed adjacent to the outer surface of the front wall 112 and cooperating with the index member 122 carried thereon. The dial 121 carries a forwardly projecting centrally disposed threaded stub 121b that supports a manually rotatable control knob 120, a centrally disposed internal opening provided in the control knob 120 being threaded as indicated at 120a and engaging the threaded stub 121b. This arrangement of the dial 121 and the control knob 120 permits rotation of the dial 121 in the clockwise direction as viewed from the front of the switch 110 by rotation of the control knob 120 in the clockwise direction; however, rotation of the dial 121 in the counterclockwise direction by the control knob 120 is positively prevented by virtue of the circumstance that the threaded portions 120a and 121b merely unscrew when the control knob 120 is rotated in the counterclockwise direction.

In the switch 110 a timer motor unit 200 is provided for the purpose of rotating the shaft 123 in the clockwise direction in timed steps. Specifically, the unit 200 is of the "Mallory" escapement type and comprises an electric motor 201 that is operated at a synchronous speed from a suitable source of 115 volts 60 cycle A. C. current supply. The motor 201 is suitably supported in the auxiliary casing 115b and is provided with an operating shaft 202 that cooperates with speed reduction gearing indicated generally at 203 for the purpose of rotating a shaft 204 extending into an escapement mechanism indicated generally at 205. The escapement mechanism 205 is so constructed and arranged that by virtue of the gearing 203 extending between the mechanism 205 and the operating shaft 202 of the motor 201, a shaft 206 is released in steps. Specifically, the shaft 206 is released each 45 seconds and rotates through $\frac{1}{2}$ revolution upon each release thereof. The shaft 206 has a pinion 207 rigidly secured therethrough that meshes with a pinion 208 rigidly secured to a shaft 209. The shaft 209 also carries a disk 210 that supports a pawl 211 that cooperates with a ratchet wheel 212 rigidly secured to a shaft 213 that projects between the auxiliary casing 115b and the main casing 115a. A pinion 216 is rigidly secured to the shaft 215 and meshes with a gear 217 that is rigidly secured to the operating shaft 123.

Considering now the general operation of the timer motor unit 200, when the motor 201 is energized, it operates to rotate the shaft 202 in the clockwise direction, as viewed from the front of the switch 110, through the gearing 203 effecting operation of the escapement mechanism 205, whereby the shaft 206 is rotated step by step $\frac{1}{2}$ revolution each step in the clockwise direction each 45 seconds. The shaft 206 effects rotation of the shaft 209 step by step in the counterclockwise direction $\frac{1}{2}$ revolution each step each 45 seconds by virtue of the gearing 207-208. Rotation of the shaft 209 step by step in the counterclockwise direction effects rotation of the shaft

213 step by step in the counterclockwise direction due to the pawl and ratchet mechanism drive 211—212, whereby the pinion 216 drives the gear 217 step by step in the clockwise direction effecting corresponding step by step rotation of the operating shaft 123. The ratio of the gearing 216—217, is 40:1, whereby upon each release of the shaft 213 through an angle of 180° each 45 seconds the operating shaft 123 is rotated through an angle of 4½° each 45 seconds. Thus, the operating shaft 123 is rotated step by step in the clockwise direction by the timer motor unit 200, 4½° each step at 45 second intervals, whereby the average rate of rotation of the operating shaft 123 is one revolution per hour.

Finally, the switch 110 comprises a plurality of insulating control cams rigidly secured to the operating shaft 123 and operatively associated with corresponding sets of switch springs. For example, the operating shaft 123 may carry the control cams C11 and C12 that respectively cooperate with the sets of switch springs S11 and S12. The circuit for the appliance 111, including the operating circuit of the electric motor 201, has not been illustrated in the interest of brevity as it is essentially the same as that of the appliance 11.

Considering now the general operation of the switch 110 when the user of the appliance 111 wishes to initiate operation thereof, he seizes the manual control knob 120 and rotates it in the clockwise direction from its "off" position into its "on" position, whereby the pawl 137 blocks further rotation of the operating shaft 118, whereby the operating shaft 123 is rotated through the lost-motion connection, including the elements 128 and 129 from its "off" position into its first "control" position. At this time, operation of the electric motor 201 is initiated, and 45 seconds thereafter the escapement mechanism 205, driven by the electric motor 201, brings about rotation of the operating shaft 123 one step in the clockwise direction through an angle of 4½°. When the operating shaft 123 is thus operated out of its first "control" position the member 127 operates the pawl 137 out of its blocking position so that the operating end of the pawl 137 disengages the shoulder 140 provided on the periphery of the cam 126, whereby the operating shaft 118 may be rotated by the user of the appliance 111 further in the clockwise direction if he so desires. Continued operation of the electric motor 201 effects continued step by step rotation of the operating shaft 123, whereby it is rotated step by step through its various "control" positions and ultimately back into its "off" position; whereupon, the circuit for energizing the electric motor 201 is interrupted arresting further operation of the switch 110. As the shaft 123 is rotated in the clockwise direction through its various "control" positions, the control cams C11 and C12 selectively operate the sets of switch springs S11 and S12 in order to effect a cycle of operation of the appliance 111.

When the operating shaft 118 is initially rotated from its "off" position into its "on" position in the clockwise direction by the manual control knob 120 the gear 217 carried by the operating shaft 123 effects rotation of the shaft 213 in the counterclockwise direction through the pinion 216, whereby the teeth on the ratchet wheel 212 override the pawl 211 carried by the disk 210 so that rotation of the shaft 213 in the counterclockwise direction does not interfere in any way with the timer motor unit 200. After

the operating shaft 123 has been rotated in the clockwise direction away from its first "control" position the pawl 137 is operated into its unblocking position as previously explained, whereby the user of the appliance 111 at this time may rotate the control knob 120 further in the clockwise direction in order to cause the switch 110 to skip or omit the corresponding one or more phases in the cycle of operation thereof and consequently of the appliance 111. In passing it is again noted that the user of the appliance 111 may not rotate the operating shaft 118 in the counterclockwise direction as rotation of the manual control knob 120 in the counterclockwise direction merely effects unthreading of the control knob 120 from the dial 121 without rotation of the dial 121 and the operating shaft 118.

In view of the foregoing, it will be understood that the arrangement of the pawl 137 in the switch 110 prevents inadvertent operation of the switch 110 through its first "control" position by the user of the appliance 111, while preserving contemplated operation of the switch 110 through its subsequent "control" positions by the user lending flexibility to the control of the associated appliance 111.

In view of the foregoing considerations it is apparent that a combined manual and timer controlled program selector switch has been provided that is especially adapted for use in controlling the cycle or program of operation of an associated appliance, such, for example, as dishwashing apparatus, or the like, wherein the program selector switch embodies facility for preventing inadvertent skipping of a predetermined control position thereof while preserving the facility of permitting contemplated skipping of other "control" positions thereof.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A program selector comprising an element having an "off" position and a plurality of "control" positions and being movable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually operable member normally able to move said element, a motor, a drive connection between said motor and said element for moving it, said drive connection accommodating movement of said element by said manually operable member independently of said motor, means responsive to movement of said element into a given one of its "control" positions by said manually operable member for disabling said manually operable member, means responsive to movement of said element into its first "control" position for initiating operation of said motor, said motor moving said element through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to movement of said element a given distance from its given "control" position by said motor for again enabling said manually operable member, means responsive to movement of said element into its "off" position for arresting operation of said motor, and means responsive to movement of said element through its

various "control" positions for effecting a predetermined cycle of control operations.

2. A program selector comprising a rotatable shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually operable member normally able to rotate said shaft, a timer, a drive connection between said timer and said shaft for rotating it, said drive connection accommodating rotation of said shaft by said manually rotatable member independently of said timer, means responsive to rotation of said shaft into a given one of its "control" positions by said manually operable member for disabling said manually operable member, means responsive to rotation of said shaft into its first "control" position for initiating operation of said timer, said timer rotating said shaft through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said shaft through a given angle from its given "control" position by said timer for again enabling said manually operable member, means responsive to rotation of said shaft into its "off" position for arresting operation of said timer, and means responsive to rotation of said shaft through its various "control" positions for effecting a predetermined cycle of control operations.

3. A program selector comprising a rotatable shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually rotatable member operatively connected to said shaft for rotating it, a timer, a drive connection between said timer and said shaft for rotating it, said drive connection accommodating rotation of said shaft by said manually rotatable member independently of said timer, stop mechanism operative to arrest rotation of said manually rotatable member, means responsive to rotation of said shaft into its first "control" positions by said manually rotatable member for operating said stop mechanism, additional means responsive to rotation of said shaft into its first "control" position for initiating operation of said timer, said timer rotating said shaft through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said shaft through a given angle from its first "control" position by said timer for releasing said stop mechanism, means responsive to rotation of said shaft into its "off" position for arresting operation of said timer, and means responsive to rotation of said shaft through its various "control" positions for effecting a predetermined cycle of control operations.

4. A program selector comprising first and second rotatable shafts, said first shaft having an "off" position and an "on" position and being rotatable sequentially from its "off" position into its "on" position and thence back into its "off" position, said second shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually rotatable member connected to said first shaft for rotating it, the "off" positions of said shafts

being substantially coincident, a lost-motion drive mechanism interconnecting said shafts so that when said first shaft is rotated through a predetermined angle from its "off" position into its "on" position said second shaft is rotated through a lesser angle from its "off" position into its first "control" position, a timer, a drive connection between said timer and said second shaft for rotating it, said drive connection accommodating rotation of said second shaft by said first shaft through said drive mechanism independently of said timer, stop mechanism operative to arrest further rotation of said first shaft, means responsive to rotation of said first shaft into its "on" position for operating said stop mechanism, means responsive to rotation of said second shaft into its first "control" position for initiating operation of said timer, said timer rotating said second shaft through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said second shaft through a given angle from its first "control" position for releasing said stop mechanism, said second shaft rotating said first shaft from its "on" position back into its "off" position through said drive mechanism, means responsive to rotation of said second shaft into its "off" position for arresting operation of said timer, and means responsive to rotation of said second shaft through its various "control" positions for effecting a predetermined cycle of control operations.

5. The program selector set forth in claim 4, wherein the sum of said lesser angle and said given angle of rotation of said second shaft is substantially equal to said predetermined angle of rotation of said first shaft.

6. A program selector switch comprising first and second rotatable shafts, said first shaft having an "off" position and an "on" position and being rotatable sequentially from its "off" position into its "on" position and thence back into its "off" position, said second shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually rotatable member connected to said first shaft for rotating it, the "off" positions of said shafts being substantially coincident, a lost-motion drive mechanism interconnecting said shafts so that when said first shaft is rotated through a predetermined angle from its "off" position into its "on" position said second shaft is rotated through a lesser angle from its "off" position into its first "control" position, an electro-responsive timer, a drive connection between said timer and said second shaft for rotating it, said drive connection accommodating rotation of said second shaft by said first shaft through said drive mechanism independently of said timer, stop mechanism operative to arrest further rotation of said first shaft, means responsive to rotation of said first shaft into its "on" position for operating said stop mechanism, a source of current supply, switching contacts, an operating circuit for said timer including said source and said switching contacts, means responsive to rotation of said second shaft into its first "control" position for closing said switching contacts in order to complete said operating circuit so as to initiate operation of said timer, said timer rotating said second shaft through said drive connection from its first "control" position

through its other "control" positions back into its "off" position, means responsive to rotation of said second shaft through a given angle from its first "control" position for releasing said stop mechanism, said second shaft rotating said first shaft from its "on" position back into its "off" position through said drive mechanism, means responsive to rotation of said second shaft into its "off" position for opening said switching contacts in order to interrupt said operating circuit so as to arrest operation of said timer, and a plurality of control contacts selectively operated in response to rotation of said second shaft through its various "control" positions in order to effect a predetermined cycle of control operations.

7. A program selector comprising first and second rotatable shafts, said first shaft having an "off" position and an "on" position and being rotatable sequentially from its "off" position into its "on" position and thence back into its "off" position, said second shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually rotatable member connected to said first shaft for rotating it, the "off" positions of said shafts being substantially coincident, a lost-motion drive mechanism interconnecting said shafts so that when said first shaft is rotated through a predetermined angle from its "off" position into its "on" position said second shaft is rotated through a lesser angle from its "off" position into its first "control" position, a timer, a drive connection between said timer and said second shaft for rotating it, said drive connection accommodating rotation of said second shaft by said first shaft through said drive mechanism independently of said timer, a first cam carried by said first shaft, a second cam carried by said second shaft, a pawl cooperating with said cams, said first cam being so constructed and arranged that said pawl is moved into stopping engagement therewith in response to rotation of said first shaft into its "on" position preventing further rotation of said first shaft, means responsive to rotation of said second shaft into its first "control" position for initiating operation of said timer, said timer rotating said second shaft through said drive connection from its first "control" position through its other "control" positions back into its "off" position, said second cam being so constructed and arranged that it moves said pawl out of stopping engagement with said first cam in response to rotation of said second shaft through a given angle from its first "control" position permitting further rotation of said first shaft, said second shaft rotating said first shaft from its "on" position back into its "off" position through said drive mechanism, means responsive to rotation of said second shaft into its "off" position for arresting operation of said timer, and means responsive to rotation of said second shaft through its various "control" positions for effecting a predetermined cycle of control operations.

8. A program selector comprising a rotatable shaft having an "off" position and a plurality of "control" positions and being rotatable in a predetermined direction sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually operable member normally able to rotate said shaft in either direction, means responsive to rotation of said shaft in either direction into a

given one of its "control" positions by said manually operable member for disabling said manually operable member to rotate said shaft further in said predetermined direction, a timer operative continuously at a predetermined rate, a friction clutch drive connection between said timer and said shaft for rotating said shaft in said predetermined direction, said drive connection accommodating rotation of said shaft in either direction by said manually rotatable member independently of said timer, means responsive to rotation of said shaft in either direction into its first "control" position by said manually operable member for initiating operation of said timer, said timer rotating said shaft in said predetermined direction through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said shaft in said predetermined direction through a given angle from its given "control" position by said timer for again enabling said manually operable member to rotate said shaft in said predetermined direction, means responsive to rotation of said shaft in either direction into its "off" position for arresting operation of said timer, and means responsive to rotation of said shaft in said predetermined direction through its various "control" positions for effecting a predetermined cycle of control operations.

9. A program selector comprising first and second and third rotatable shafts, speed-change gearing interconnecting said second and third shafts so that when either one of said two last-mentioned shafts is rotated at one speed the other of said two last-mentioned shafts is driven at another speed, said first shaft having an "off" position and an "on" position and being rotatable sequentially from its "off" position into its "on" position and thence back into its "off" position, said second shaft having an "off" position and a plurality of "control" positions and being rotatable sequentially from its "off" position through its various "control" positions and thence back into its "off" position, said third shaft having a plurality of "control" positions and being rotated sequentially therethrough, a manually rotatable member connected to said first shaft for rotating it, the "off" positions of said first and second shafts being substantially coincident, a lost-motion drive mechanism interconnecting said first and second shafts so that when said first shaft is rotated through a predetermined angle from its "off" position into its "on" position said second shaft is rotated through a lesser angle from its "off" position into its first "control" position, a timer, a drive connection between said timer and said third shaft for rotating it, said drive connection accommodating rotation of said second shaft by said first shaft through said drive mechanism and rotation of said third shaft by said second shaft through said gearing independently of said timer, stop mechanism operative to arrest further rotation of said first shaft, means responsive to rotation of said first shaft into its "on" position for operating said stop mechanism, means responsive to rotation of said second shaft into its first "control" position for initiating operation of said timer, said timer rotating said third shaft through said drive connection and rotating said second shaft from said third shaft through said gearing from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said second shaft through a

given angle from its first "control" position for releasing said stop mechanism, said second shaft rotating said first shaft from its "on" position back into its "off" position through said drive mechanism, means responsive to rotation of said second shaft into its "off" position for arresting operation of said timer, and means jointly responsive to rotation of said second and third shafts through their various "control" positions for effecting a predetermined cycle of control operations.

10. A program selector comprising a rotatable shaft having an "off" position and a plurality of "control" positions and being rotatable in a predetermined direction sequentially from its "off" position through its various "control" positions and thence back into its "off" position, a manually operable member normally able to rotate said shaft in said predetermined direction and unable to rotate said shaft in the opposite direction, means responsive to rotation of said shaft in said predetermined direction into its first "control" position by said manually operable member for disabling said manually operable member to rotate said shaft further in said predetermined direction, a timer operative intermittently at a predetermined rate, a pawl-ratchet drive connection between said timer and said shaft for rotating said shaft intermittently in said predetermined direction, said drive connection accommodating rotation of said shaft in said predetermined direction by said manually rotatable member independently of said timer, additional means responsive to rotation of said shaft in said predetermined direction into its first "control" position by said manually operable member for initiating operation of said timer,

said timer rotating said shaft intermittently in said predetermined direction through said drive connection from its first "control" position through its other "control" positions back into its "off" position, means responsive to rotation of said shaft in said predetermined direction through a given angle from its first "control" position by said timer for again enabling said manually operable member to rotate said shaft in said predetermined direction, means responsive to rotation of said shaft in said predetermined direction into its "off" position for arresting operation of said timer, and means responsive to rotation of said shaft in said predetermined direction through its various "control" positions for effecting a predetermined cycle of control operations.

11. The program selector set forth in claim 10, wherein said drive connection between said timer and said shaft also includes speed reduction gearing so that each intermittent operation of said timer effects only a small angular step of rotation of said shaft in said predetermined direction.

RALPH L. BERG.

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