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PROGRAM SELECTOR SWITCH

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115 V 60^° A.C. Source

FIG. 3

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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 control of 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 insulated 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 a 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 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 de-
scribed, an arrangement responsive to rotation
table of 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 oper-
able control dial, whereby inadvertent skipping
of the first control phase of the switch by the
user is avoided while preserving 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 de-
scribed, an improved stop mechanism that is
selectively operative to block and to unblock rota-
tion 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
time.

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 there-
of are attained.

The invention, both as to its organization and
method of operation, together with further ob-
jects and advantages thereof, will best be under-
stood 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 em-
bodying the present invention; Figure 2 is a frag-
mentary exploded perspective view of the prin-
cipal operating mechanism of the switch shown
in Figure 1; Figure 3 is a partial electric diagram of
the circuit control arrangement of an appliance
in which the switch of Figure 1 is incorporated;
Figure 4 is a longitudinal sectional view of a modi-
fied form of the program selector switch em-
bodying the present invention; and Figure 5 is a frag-
mentary exploded perspective view of the prin-
cipal operating mechanism of the switch shown
in Figure 4.

Referring now to Figures 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 gen-
erally 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 combina-
tion manually and timer controlled type and
comprises a front plate 14 having a casing 15 det-
achably secured thereto and carrying a support-
ing bracket 16 within the casing 15, the bracket
16 being secured to the plate 16 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 toward the inner
der of the shaft 18, the shafts 18 and 23 being ar-
anged in axial alignment. More particularly,
the outer end of the shaft 23 carries a forwardly
projecting pin or bearing portion 24 that is re-
cieved in a cooperating cylindrical bearing open-
ing 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
der of the shaft 18 and a gear 27 rigidly secured
to the outer end of the shaft 23. More partic-
ularly, the cam 26 is provided with a rearwardly
extending finger 28 that projects into an arcuate
shaped slot or opening 29 formed in the shaft 18,
the arcuate width of the finger 28 being some-
what 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 mechanism.

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 jour-
naled in an opening provided in the plate 14 and
the inner end of the stub shaft 31 is suitably jour-
naled 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 ex-
plained hereinafter.
The shafts 23 and 30 are interconnected by a speed-change gearing ar-
rangement 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 where-
by one revolution of the shaft 23 effects three revolutions of the shaft 30 and one revo-
lution of the shaft 30 effects 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 "drop in" 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 con-
structed 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 me-
chanism that is selectively operative to block and
to unblock rotation of the manually rotatable
shaft 18 and including a cam 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 about the inner 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 switch spring and the intermediate switch spring and that it may selectively move the intermediate switch spring 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 pin 35 is disposed coincident with 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 to its "on" position, the operating end of the pawl 37 engages the shoulder 40 provided on the cam 25 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 25 provided on the cam 25 moves in the slot 29 providing 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 39 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 35.

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 32; 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 counterclockwise 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 25 and is thus displaced so that it is no longer engaged with the shaft 18, whereby the shaft 23 is rotated through a small given angle in the counterclockwise direction independently of the shaft 18 and corresponding to the lost-motion between the finger 25 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 35 and against the bias of the coil spring 39, whereby the operating end of the pawl 37 engages the shoulder 40 provided on the cam 25. At this time when the lost-motion has been taken up between the finger 23 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, respectively engaging the gear 27 in the engagement between the slot 29 and the finger 25.

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 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 gear 37, 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 operating element for the device D1 and the gear 27 is taken up by the gear 21 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, and 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 S4 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 S3 and S4.

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 successively 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. The control cam C3 is taken up by the gear 21 to initiate further rotation of the cam 26 and the shaft 23 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 one of the components 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 may be selectively omitted or repeated.

In passing, it is noted that in the construction of the switch 10 the main control dial 25 is always selectively rotatable in the counterclockwise direction since the pawl 37 is selectively operative only to block the rotation of the shaft 10 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 25 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 shaft 21 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.

Refering 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 electric 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 1150 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 208 extending between the mechanism 205 and the operating shaft 202 the shaft 206 is released in steps. Specifically, the shaft 206 is released each 45 seconds and rotates through 45 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 2150 and the main casing 2155. A pinion 216 is rigidly secured to the shaft 215 and meshes with a gear 217 that is rigidly secured to the operating shaft 110.

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 the operation of the escapement mechanism 205, whereby the shaft 205 is rotated 45 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 45 revolution each step each 45 seconds by virtue of the gearing 208-209. Rotation of the shaft 206 step by step in the counterclockwise direction effects rotation of the shaft
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213 step by step in the counterclockwise direction due to the pawl and ratchet mechanism drive 211-212, whereby the pinion 210 drives the gear 217 step by step in the clockwise direction effecting corresponding step by step rotation of the operating shaft 23. The engaging 216-217, is 40:1, whereby upon each release of the shaft 213 through an angle of 180° each 45 seconds the operating shaft 213 is rotated through an angle of 4½° each 45 seconds. Thus, the operating shaft 213 is rotated step by step in the clockwise direction by the ratchet mechanism drive 211-212, 4½° each step at 45 second intervals, whereby the average rate of rotation of the operating shaft 213 is one revolution per hour.

Finally, the switch 110 comprises a plurality of insulting control cams rigidly secured to the operating shaft 213 and operatively associated with corresponding sets of switch springs. For example, the operating shaft 213 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 this interest of brevity as it is essentially the same as that of the appliance 111.

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 counterclockwise 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 213 is rotated through the lost-motion connection, including the elements 126 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 213 one step in the clockwise direction through an angle of 4½°. When the operating shaft 213 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 shouldering 240 provided on the periphery of the cam 126, whereby the operating shaft 118 may be rotated by the user of the appliance 111 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 213, 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 210. As the shaft 213 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 213 effects rotation of the shaft 215 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 213 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 may rotate the manual 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 rotate the manual control knob 120 in the counterclockwise direction merely effects unthreading of the control knob 120 from the dial 212 without rotation of the dial 212 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 with its associated “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 including one or more of said positions, said element being rotatable in the counterclockwise direction from its “off” position through 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 into said 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 into one of said first “control” positions by said manually operable member for disabling 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 first "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 independently of said timer, 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 for releasing said stop mechanism, means responsive to rotation of said shaft into its "off" position for arresting operation of said shaft, 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 operatively 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, and means responsive to rotation of said second shaft into its "on" 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 operatively 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 for energizing said 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 independent of said first shaft 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 cam carried by said first shaft, a pawl cooperating with said cam, said first cam being so constructed and arranged that said pawl is moved into stopping engagement therewith in 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 to 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 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.
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.

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