May 4, 1954 W. R. MILLER 2,677,732

TIME SWITCH

Filed Sept. 18, 1946 2 Sheets-Sheet 1

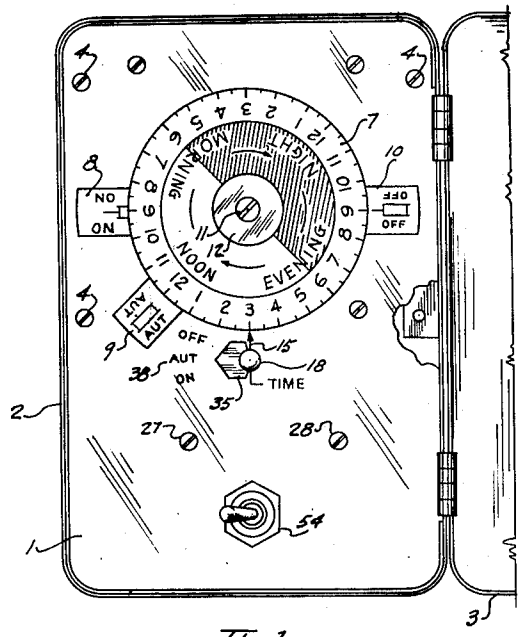


Fig. 1

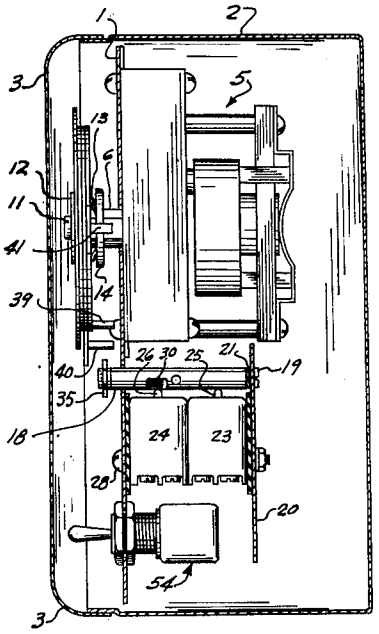


Fig. 2

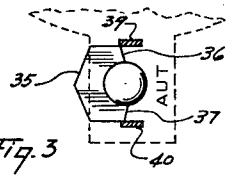


Fig. 3

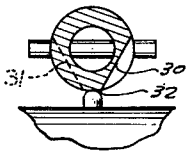


Fig. 6

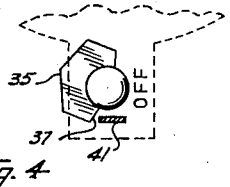


Fig. 4

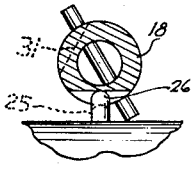


Fig. 7

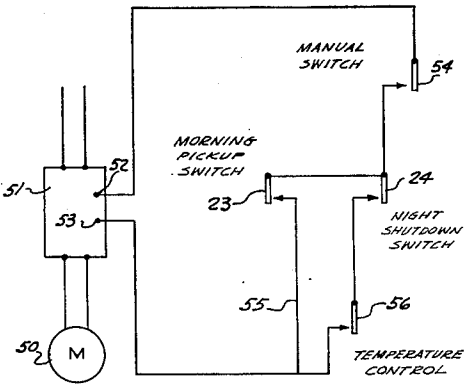


Fig. 9

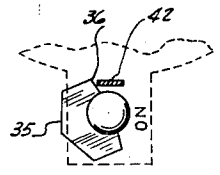


Fig. 5

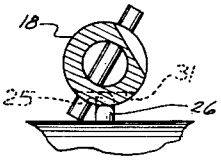


Fig. 8

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TIME SWITCH

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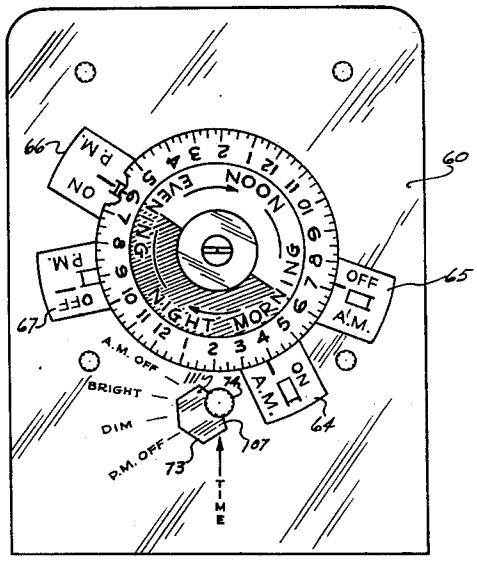


Fig. 10

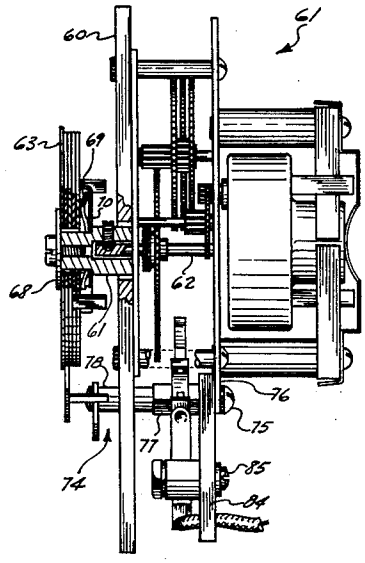


Fig. 11

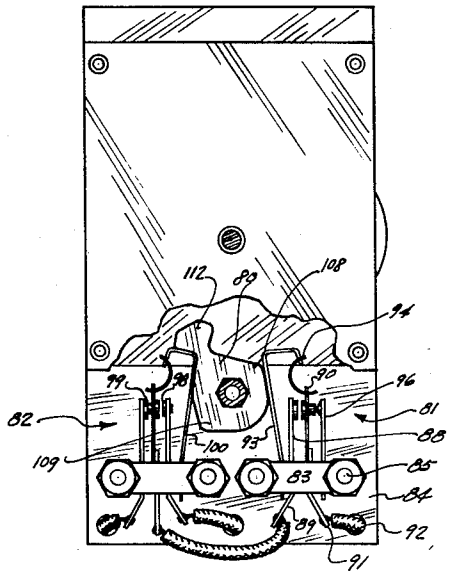


Fig. 12

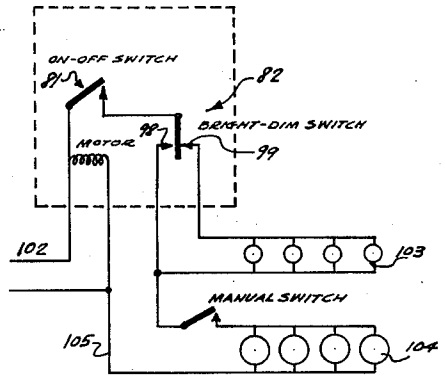


Fig. 13

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UNITED STATES PATENT OFFICE

2,677,732

TIME SWITCH

Wayland R. Miller, Milwaukee, Wis.

Application September 18, 1946, Serial No. 697,816

16 Claims. (Cl. 200—38)

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This invention relates in general to automatic controls and is more particularly concerned with timing devices.

The primary object of this invention is to provide a time switch or control which performs a plurality of different switching operations in a predetermined sequence and in which the desired times of operation may be easily set by an untrained user.

A further object of the invention is to provide a device of the above character which is extremely simple and rugged in construction and which is easy to understand and use.

Other objects will become apparent from the following description and the appended claims.

For a full disclosure of my invention, reference is made to the following description and the accompanying drawings in which

Fig. 1 is a front view of a timer embodying the present invention;

Fig. 2 is a side view partially in section of the device shown in Fig. 1;

Figs. 3, 4 and 5 are a series of fragmentary views showing different operating positions of the actuating cam for the cam shaft;

Figs. 6, 7 and 8 are a series of fragmentary views showing positions of the cam shaft and switch mechanism corresponding to Figs. 3, 4 and 5 respectively;

Fig. 9 is a wiring diagram showing one application of this embodiment of the invention;

Fig. 10 is a front view of a modified form of the invention for a different application or use;

Fig. 11 is a side view of Fig. 10, partially in section;

Fig. 12 is a view of the timer behind the panel showing the switches and operating mechanism therefor, and

Figure 13 is a wiring diagram showing an application for this form of the invention.

For subject matter disclosed but not claimed in this application, reference is made to my copending application Serial No. 697,815, filed September 18, 1946, now Patent No. 2,633,508, dated March 31, 1953.

Referring to Figure 1, reference character 1 indicates a panel which is mounted in a suitable enclosure 2, having a hinged cover 3, by means of screws 4 which are threaded into suitable mounting brackets on the enclosure at the rear of the panel. The panel 1 at its upper end carries a synchronous motor and gear train mechanism 5, this mechanism having a final drive shaft extending through the panel to which a hub 6 is attached. The hub member in the embodiment shown carries a 24-hour dial 7, an "on" actuator 8, an "automatic" actuator 9 and an "off" actuator 10. As shown in Figure 2 the actuators 8, 9 and 10 have flat generally circular portions located behind the dial and also have finger like portions extending beyond the dial as appear in Figure 1. The dial and actuators are provided with holes through which the hub extends, the holes being slightly larger than the hub so that the dial and actuators are free to turn thereon. A screw 11 holds a front friction plate 12 firmly against the front of the hub, this plate serving to provide friction between the hub and the front surface of the dial. A friction spring 13 is located behind the rearmost actuator and bears against a rear friction plate or cupped washer 14 which abuts a shoulder on the hub member 6. With this arrangement the dial and the three actuators are clamped between the front friction plate and the friction spring, this providing a friction drive between the hub and the dial and actuators. With this friction drive the dial may be set on the hub for the correct time as indicated by the time arrow 15 on the front panel. Also, with this arrangement the actuators may be readily adjusted on the dial for the desired times of switch operation.

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Located below the dial is a cam shaft 18. This shaft extends freely through a hole in the panel 1 and the rear end is supported by a screw 19 which extends loosely through a rear plate 20. A friction washer 21 is interposed between the rear end of the shaft 18 and the plate 20 for providing a slight amount of resistance to turning of the shaft 18. Located below the shaft 18 are a pair of enclosed snap switches 23 and 24. These switches are of a type well known in the art, the switch 23 having a spring pressed plunger 25 and the switch 24 having a similar plunger 26. The switches 23 and 24 are held in place on the panel by means of screws 27 and 28 which extend through suitable mounting holes in the switch enclosures and which also extend through suitable holes in the rear plate 20. The screws 27 and 28, therefore, serve to mount both switches and the rear plate 20 rigidly to the front panel 1.

The shaft 18 is generally round but is provided with two flat chord-like sections or segments 30 and 31. The flat section 30 is located on the right hand side of the shaft as seen in Figure 6 and is adjacent the operating plunger 26 of the snap switch 24. The flat section 31 is on the left side of the shaft and is located opposite the plunger 25 of the snap switch 23 as will be seen in Figure 6. The flat sections are angularly lo-

cated on the shaft so as to provide an intermediate or neutral section 32 wherein both plungers 25 and 26 are depressed.

Attached to the front end of the cam shaft is a cam member 35. This cam member as indicated in Figure 3 is provided with an upper engaging surface 36 and a lower engaging surface 37. The cam member is also formed as a pointer and cooperates with indicia 38 on the front panel for indicating the position of the cam shaft. The cam 35 is operated by the actuators 8, 9 and 10. To this end the actuators are provided with rearwardly extending ears which are punched from the material of the actuators. Thus the "automatic" actuator is provided with ears 39 and 40, the "off" actuator is provided with an ear 41, and the "on" actuator is provided with an ear 42.

When the "off" actuator 10 passes the cam 35, the ear 41 on this actuator engages the lower surface 37 of the cam and causes rotation of the cam to the position indicated as "off." At this time the ear 41 rides off the end of the surface 37 and the actuator remains in this position. When the "on" actuator passes the cam 35, the ear 42 on this actuator engages the upper operating surface 36 of the cam 35, this causing counterclockwise rotation of the cam and its shaft to the position indicated as "on." When the cam reaches this position the actuator 42 rides off the end of the surface 36 of the cam and the cam thus remains in the "on" position. When the "automatic" actuator 9 passes the cam the ears 39 and 40 engage the top and bottom surfaces of the cam and thus move it to the center or "automatic" position. This action occurs irrespective of whether the cam was at "off" or "on" at the time it is engaged by the "automatic" actuator.

One important application for the time switch above described is for day-night control of heating systems for large buildings which are controlled by weather controls rather than by inside thermostats. In this type of installation, the heating system is shut off entirely at night and is returned to the control of the weather control in the morning. The weather control, however, does not respond to the temperature of the building and would function merely to supply enough heat to balance the heat loss from the building. With this type of system it is therefore necessary to provide a constant "on" period in the morning during which the stoker or oil burner operates independently of the weather control for bringing the building temperature back to normal. When the time switch above described is to be used in this type of system, the switch 23 is made "normally closed" and the switch 24 is made "normally open." In other words, when the plunger 25 of the switch 23 is in its outer position the switch is closed and when this plunger is depressed the switch opens. When the plunger of switch 24 is in its outer position the contacts are open and when the plunger is depressed the contacts close.

Figure 9 indicates a wiring diagram showing the hookup for the above described installation. The stoker or oil burner motor 50 is controlled by a motor starter 51 having control terminals 52 and 53. The terminal 52 is connected to a manual switch 54 which may be mounted on the panel 1 below the snap switches. The other side of switch 54 is connected to one terminal on both the switch 23 and switch 24. The switch 23 is connected directly to the terminal 53 of the motor starter by wire 55 and the switch 24 is wired in series with the weather control 56 which is also connected with the terminal 53 of the motor starter.

During the day the cam 35 is in its intermediate or "automatic" position, shown in Figure 3. At this time the cam shaft is in the position shown in Figure 6 is which both snap switch plungers are depressed. As the switch 23 is of the normally closed variety, the depressed plunger of this switch causes it to be in open position. As the switch 24 is of the normally open variety the depressed plunger 25 causes this switch to be closed. Assuming the manual switch 54 is closed the burner is then under the control of the temperature or weather control 56 which starts and stops the burner in proportion to the heating load.

At night the "off" actuator passes the cam 35 and actuates it to the "off" position as shown in Figure 4. This causes the cam shaft 18 to assume the position shown in Figure 7, in which the plunger 26 of snap switch 24 is in its outer position causing this switch to be open. The plunger 25 of the switch 23 has remained at its inner position and this switch is therefor also open. Due to both switches 23 and 24 being open, the temperature control 56 cannot start the burner and the heat is thus off for the night.

The "on" actuator would be set on the dial to approximately 6:00 a. m. and would thus pass the cam 35 at this time. This will move the cam 35 from the "off" position as shown in Figure 4 to the "on" position as shown in Figure 5. At this time the cam shaft 18 will assume the position shown in Figure 8 in which the plunger 26 of snap switch 24 is depressed and the plunger 25 of switch 23 is in its outer position. These positions of the plungers cause both switches 23 and 24 to be closed. The switch 23 shunts out the temperature control 56 and thus provides for constant operation of the burner irrespective of the temperature control 56.

The "automatic" actuator would be set on the dial for approximately 7:30 a. m. At this time the automatic actuator passes cam 35 causing it to assume the position as shown in Figure 3 this causing the cam shaft to assume the position shown in Figure 6. As previously pointed out this position of the cam shaft causes the switch 23 to be open and the switch 24 to be closed thus providing for automatic control of the burner by the temperature control 56.

From the foregoing description it will be apparent that the present invention provides a simple and easily adjusted control for operating the switches 23 and 24 in the proper sequence for obtaining the desired results. It should be noted that due to the actuator construction in which the ears on one actuator prevent the passing of another actuator the actuators once assembled properly will always be in the proper sequence, and it is impossible for the user to get the fingers adjusted in the wrong sequence.

Referring to Figures 10, 11, 12 and 13 these figures show the application of the invention to a special timer for use in poultry houses. In this application, the invention serves to turn the lights from off to dim in the morning. After a timed period the lights turn from dim to bright. The lights then remain on bright until it is desired for them to go off. The lights go from bright to off directly without going through a dimming period. At night when lights are desired, the lights turn from off to bright directly and remain on bright until it is desired for them to

go off. At this time the lights change from bright to dim, remaining dim for a timed period, and then go off.

Referring to the particular construction, a panel 60 serves to support a motor and gear train mechanism generally indicated as 61. The gear train has a final drive shaft 62 which extends through the panel 60 and which is attached to a hub member 61. This hub member carries a dial 63, an "on—a. m." actuator 64, an "off—a. m." actuator 65, an "on—p. m." actuator 66 and an "off—p. m." actuator 67. The dial and actuators are freely mounted on the reduced portion of the hub and are clamped between a front friction plate 68 and a friction spring 69 which abuts a rear friction plate 70 which in turn abuts a shoulder on the hub member. The dial and actuators are thus yieldably held on the hub and may be adjusted on the hub independently of each other. The actuators 64, 65, 66 and 67 are each provided with inwardly extending ears for operating a cam member 73 which is mounted on a cam shaft 74 extending through the panel 60. The rear end of this shaft is supported by a screw 75 which loosely fits through a hole in the gear train plate 76. As shown in Figure 11, cam shaft 74 has a rear portion 77 which is hexagon shaped and a front portion 78 which is circular and which extends through the panel 60. The rear or hexagon portion of the cam shaft supports a switch operating cam 80 which serves to actuate over center type snap switches 81 and 82.

The snap switch 81 includes a base portion 83 which is mounted on a mounting plate 84 by screws 85. The plate 84 as shown in Figure 11 is supported from the lower end of the plate 76 which supports the synchronous motor and a portion of the gear train. Embedded in the base portion 83 of the snap switch is a stiff switch blade 88 carrying a stationary contact at its upper end. This blade 88 is attached to a wiring lug 89 protruding from the bottom of the base 83. Also supported in the base 83 is a flexible blade 90 which carries a contact for cooperating with the contact first mentioned. The lower end of the flexible blade is attached to a wiring lug 91 which is in turn attached to a lead 92 which passes through a hole in the base 84. The snap switch also includes a spring operating member 93, the lower end of which is mounted in the base 83 and which extends upwardly adjacent the cam 80. The upper end of the operating member 93 is bent over and is provided with a tongue engaging a C-spring 94. The other end of the C-spring 94 is engaged by a protruding tongue in the flexible switch blade 90. The switch 81 also includes a stop blade 96 which extends upwardly and is provided with a button adapted to be engaged by the contact on the flexible blade 90. When the blade 93 is in the position shown, the C-spring 94 provides a component of force which holds the flexible blade 90 against the stop blade 96 this causing the switch contacts to be open. When the spring operating member 93 is pressed to the right against its bias, the point of support for the upper end of the C-spring 94 is shifted to the right which eventually causes a component of force urging the spring contact blade 90 to the left for engaging the contacts. Thus movement of the operating member 93 to the right causes the contacts to engage with snap action and movement of this operating member to the left causes the contacts to disengage with snap action.

The snap switch 82 is similar to the switch 81 but is of the double throw type. In other words, this switch is provided with 2 sets of contacts 98 and 99. When the spring operating member 100 is moved to the left the contacts 99 disengage and contacts 98 engage. When the spring operating member moves to the right the reverse action takes place. It will be understood that the engagement and disengagement takes place with snap action in both directions.

Figure 13 shows one form of installation of the poultry house timer. It will be seen that the "on-off" switch 81 is connected to the "hot" line 102 and the other side of the switch is connected to the common blade of the switch 82. The contact 99 of switch 82 is connected to a resistance bank 103 and the contact 98 of switch 82 is connected directly to the main lamp bank 104, the other side of which is connected to the ground line 105.

With the parts in the position shown the cam 73 is in the position marked "p. m.—off" which causes the switch operating cam 80 to be in the position shown in Figure 12. In this position the operating member 93 of the switch 81 is at its extreme left position which causes the switch 81 to be open. The operating member 100 of the switch 82 is in its right hand position which has caused the common blade of switch 82 to engage contact 99. Due to the switch 81 being opened the lights are out. As the "on—a. m." actuator 64 rotates past the cam 73, the ear on this actuator will engage the lower operating surfaces 107 of the cam 73 thereby rotating the cam shaft clockwise. The first action that takes place is for the protrusion 108 of cam 80 to urge the switch operating member 93 to the right for causing the switch 81 to snap to its closed position. This establishes a circuit through switch 81 contacts 99 of switch 82, resistance bank 103, and lamp bank 104 to the ground line 105. The resistance bank 103 is thus in series with the main lamp bank with the result that the main lamp bank burns dimly. On continued rotation of the dial assembly (approximately 15 minutes) the "on—a. m." actuator will continue to rotate the cam shaft 74 clockwise until the cam 73 reaches a position between the words "dim" and "bright" on the panel 60. At this time the protrusion 109 on the cam 80 has engaged the operating member 100 of switch 82 and has shifted this operating member far enough to the left to cause this switch to snap, thus disengaging contact 99 and engaging contact 98. This shunts out the resistance bank 103 and thus causes the main lamp bank to burn at full brilliance. When the cam 73 reaches a position opposite the word "bright" the ear on the actuator 64 disengages the lower operating surface 107 of the cam and the cam shaft remains stationary in this position. At this time the protrusions 108 and 109 on the cam are on a line passing horizontally through the axis of the cam shaft. Thus the inward spring effects of the operating members 93 and 100 are balanced out and the cam shaft remains stationary in this position. When the "a. m.—off" actuator 65 passes the cam 73, the ear on this actuator engages the cam by reason of the fact that this ear is located closer to the axis of rotation of the dial assembly of the corresponding ear on the actuator 64. Engagement of the actuator 65 with the cam 73 causes the cam shaft to continue rotating in a clockwise direction until it reaches the position "a. m.—off". At

this time the protrusion 106 on the cam 80 has moved downwardly to a point at which it permits movement of the operating member 93 to the left as the cam rotates clockwise. The switch 81 thus snaps to open position. The lights, therefore, at this time go directly from bright to off.

In the evening the "on—p. m." actuator passes the cam 73 and an ear on this actuator engages the upper surface 111 of the cam 73 and causes the cam to travel from the position "a. m.—off" to "bright." During this movement the protrusion 108 on the cam 80 has travelled upwardly and outwardly thereby urging the switch operating member 93 to the right for causing switch 81 to close. At this time the switch 82 has already been positioned to engage contact 98. Therefore, when switch 81 closes, the circuit is completed directly to the main lamp bank for causing it to burn at full brilliance. The ear on the "on—p. m." actuator 66 disengages the cam 73 in the "bright" position and the lights thus stay on bright until the cam is engaged by the "off—p .m." actuator 67. The ear on this "off—p. m." actuator engages the upper surface of cam 73 and causes the cam to travel counterclockwise from "bright" to "p. m.—off." As the cam travels between the words "bright" and "dim" on the panel, the protrusion 109 on the cam 80 moves away from the switch operating member 100 thus permitting this switch to return to the position shown in Figure 3 in which the contacts 99 are engaged. The lamps at this time, therefore, burn at dim. As the dial assembly continues to rotate (approximately 15 minutes) it rotates the cam 73 to the "p. m.—off" position shown in Figure 12 at which time the switch 81 opens and turns out the lights.

It will be noted that the cam 80 is formed with an extension 112. This extension provides surfaces adapted to engage the upper portions of the operating members 93 and 100. This provides a stop for the cam shaft 74 and limits its rotation so that it cannot be moved to a position in which it cannot be picked up by the ears on the actuators.

From the foregoing description it will be apparent that the present invention provides a simple mechanism for operating a plurality of switches or control devices in predetermined or specified manner and which is readily adjusted and understood by the user. It will also be apparent that the invention provides a flexible mechanism which may be readily adapted to perform a number of specialized functions. While I have shown and described only two embodiments of the invention it will be understood that many variations may be made without departing from the spirit and scope of the invention. It is therefore desired to be limited only by the scope of the appended claims.

What is claimed is:

1. In a time control, the combination of, a timing motor, a plurality of control devices, means including cam means having segments arranged to actuate said control devices separately in a predetermined sequence, and means including a series of actuators moved by said timing motor for operating said cam means in a predetermined sequence, one of said actuators being constructed and arranged to move said cam means in one direction and another actuator being constructed and arranged to move said cam means in the opposite direction.

2. In a time control, the combination of, a timing motor, a plurality of individually operable

control devices, means including a common operating member for operating said control devices separately in a predetermined sequence upon movement of said operating member, and means including a series of actuators movable by said timing motor for moving said operating member to predetermined positions at predetermined times, one of said actuators being constructed and arranged to move the operating member in one direction and another actuator being constructed aand arranged to move the operating member in the opposite direction.

3. In a time control, the combination of, a timing motor, a plurality of individually operable control devices, means including a cam shaft having segments arranged to actuate said control devices in a predetermined sequence upon rotation of said cam shaft, and means including a series of actuators rotated by said timing motor for rotating said cam shaft to predetermined angular positions at predetermined times, one of said actuators being constructed and arranged to rotate the cam shaft in one direction and another of said actuators being constructed and arranged to rotate the cam shaft in the opposite direction.

4. In a time control, the combination of, a timing motor, a cam shaft, a plurality of individually operable control devices, said control devices each having an operating member biased against said cam shaft, and means including a plurality of actuators moved by said timing motor for moving said cam shaft to predetermined positions at predetermined times, one of said actuators being constructed and arranged to move said cam shaft in one direction and another of said actuators being constructed and arranged to move the cam shaft in the opposite direction.

5. In a time switch mechanism, the combination of, a timing motor, a drive shaft rotated by the timing motor, a cam shaft spaced from the drive shaft and substantially parallel with the drive shaft, a plurality of switches arranged to be operated by said cam shaft in a predetermined sequence upon rotation of said cam shaft, a plurality of individually adjustable actuators mounted on said drive shaft and extending therefrom, and means engaged by said actuators for rotating said cam shaft to predetermined angular positions, one of said actuators being constructed and arranged to rotate the cam shaft in one direction and another of said actuators being constructed and arranged to rotate the cam shaft in the opposite direction.

6. In a time switch mechanism, the combination of, a timing motor, a drive shaft rotated by the timing motor, a cam shaft spaced from the drive shaft and substantially parallel with the drive shaft, a plurality of individually operable switches, said cam shaft having cam surfaces arranged to operate said switches separately and in a predetermined sequence upon rotation of the cam shaft, actuating cam means on the cam shaft and having a first engageable portion on one side of the shaft and a second engageable portion on the other side of the shaft, and a plurality of individually adjustable actuators mounted on the drive shaft for rotating the cam shaft to predetermined positions at predetermined times, one of said actuators engaging one of said engageable portions of the cam means for rotating the cam shaft in one direction and another of said actuators engaging the other of said en-

gageable portion of the cam means for rotating the cam shaft in the opposite direction.

7. A device as set forth in claim 6 in which the cam means is formed to provide an indicator for the shaft position, and indicia cooperating with said indicator for indicating the effective positions of said switches.

8. In a time switch mechanism the combination of a timing motor, switching mechanism having at least three different combinations of contact positions, an operating member for said switching mechanism, said operating member having a first position providing a first combination of contact positions, a second position providing a second combination of contact positions, and an intermediate position providing a third combination of contact positions, and a plurality of actuators driven by said timing motor, one of said actuators being constructed and arranged to move said operating member in one direction to one of said positions and another of said actuators being constructed and arranged to move said operating member in the opposite direction to another of said positions.

9. In a time switch mechanism the combination of a timing motor, switching mechanism having at least three different combinations of contact positions, and operating member for said switching mechanism, said operating member having a first position providing a first combination of contact positions, a second position providing a second combination of contact positions, and an intermediate position providing a third combination of contact positions, and at least three separate actuators driven by said timing motor, one of said actuators moving said operating member in one direction to said first position, another actuator moving the operating member in the opposite direction to said second position, and the third actuator moving said operating member only to said intermediate position.

10. In a time switch mechanism especially adapted for controlling heating systems having an automatic cycling control for controlling heat output in accordance with weather load, the combination, of switching mechanism providing an "off" position, an "on" position, and an "automatic" position, a timing motor, and three separate individually adjustable actuators driven by the timing motor, the first of said actuators being arranged to move the switching mechanism to the "off" position, the second of the actuators being arranged to move the switching mechanism to the "on" position, and the third of said actuators being arranged to move the switching mechanism to the "automatic" position, in the sequence specified.

11. In a time switch mechanism, the combination of a timing motor, a switching mechanism, a rotatable shaft for operating said switching mechanism upon rotation thereof, said shaft having two terminal positions and an intermediate position, cam means for rotating said shaft, a first actuator driven by the motor and adapted to engage the cam means for rotating the shaft to one of its terminal positions, a second actuator driven by the motor and adapted to engage the cam means for rotating the shaft to its other terminal position, and a third actuator driven by the motor and adapted to engage the cam means, said third actuator being constructed and arranged to actuate the cam means to move said shaft to said intermediate position.

12. In a time switch mechanism, the combination of a timing motor, a switching mechanism, a rotatable shaft for operating said switching mechanism upon rotation thereof, said shaft having two terminal positions and an intermediate position, cam means for rotating said shaft, a first actuator driven by the motor and adapted to engage the cam means for rotating the shaft to one of its terminal positions, a second actuator driven by the motor and adapted to engage the cam means for rotating the shaft to its other terminal position, and a third actuator driven by the motor, said third actuator having a first abutment adapted to engage the cam means for moving the shaft from one of its terminal positions to an intermediate position and having a second abutment means adapted to engage the cam means for moving the shaft from the other of its terminal positions to an intermediate position.

13. In a time switch especially adapted for poultry houses the combination of, switching mechanism including a movable operating element therefore movable between two terminal positions, said element and switching mechanism being constructed and arranged to provide an on to off switching operation as the operating element is moved to either of its terminal positions, and being further constructed and arranged to provide a bright-dim switching operation intermediate said terminal positions, a timing motor, means including a first actuator driven by the timing motor for shifting the element from one of its terminal positions past said intermediate position to an intermediate stopping position, a second motor driven actuator for shifting said element from said stopping position to the other terminal position, a third motor driven actuator for shifting the element from the latter terminal position back to said intermediate stopping position, and a fourth motor driven actuator for shifting the element back to the initial terminal position.

14. In a time switch mechanism, a timing motor, a pair of switches, a cam shaft for operating said switches, and cam shaft being rotatable between two terminal positions and having cam surfaces arranged to close one of said switches upon rotation from either terminal position and to open said one switch at either terminal position, said cam shaft also having cam surfaces arranged to operate the other of said switches intermediate its travel between said terminal positions and means operated by the timer motor for rotating said cam shaft from one of said terminal positions to the other.

15. In a time switch mechanism, a timing motor, a pair of switches, a cam shaft for operating said switches, said cam shaft being rotatable between two terminal positions and having surfaces arranged to close one of said switches upon rotation from either terminal position and to open said one switch at either terminal position, said cam shaft also having surfaces arranged to operate the other of said switches intermediate its travel between said terminal positions, and means operated by the timer motor for operating said cam shaft in steps from one of its terminal positions to the other and back again at predetermined times.

16. In a time switch mechanism, the combination of, a timing motor, a drive shaft rotated by the timing motor, a cam shaft spaced from the drive shaft and substantially parallel with the drive shaft, said cam shaft being rotatable in opposite directions between two terminal posi-

tions, contact mechanism for controlling a pair of circuits and constructed to close either one circuit or the other or to break both of said circuits, means including cam surfaces and cam follower means cooperating with the cam surfaces for positioning said contact mechanism in accordance with the angle of rotation of said cam shaft, said cam surfaces and cam follower means being constructed and arranged to actuate the contact mechanism in a predetermined sequence for closing one or the other of said circuits and to open both of said circuits as the cam shaft is rotated from one of said terminal positions to the other, actuating cam means on the cam shaft and having a first engageable portion on one side of the shaft and a second engageable portion on the other side of the shaft, and a plurality of individually adjustable actuators mounted on the drive shaft for rotating the cam shaft to predetermined positions at predetermined times, one of said actuators engaging one of said engageable portions of the cam means for rotating the cam shaft in one direction and another of said actuators engaging the other of said engageable portions of the cam means for rotating the cam shaft in the opposite direction.

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