

Oct. 7, 1958

B. GARRARD

2,855,476

TIME SWITCH

Filed June 25, 1954

2 Sheets-Sheet 1

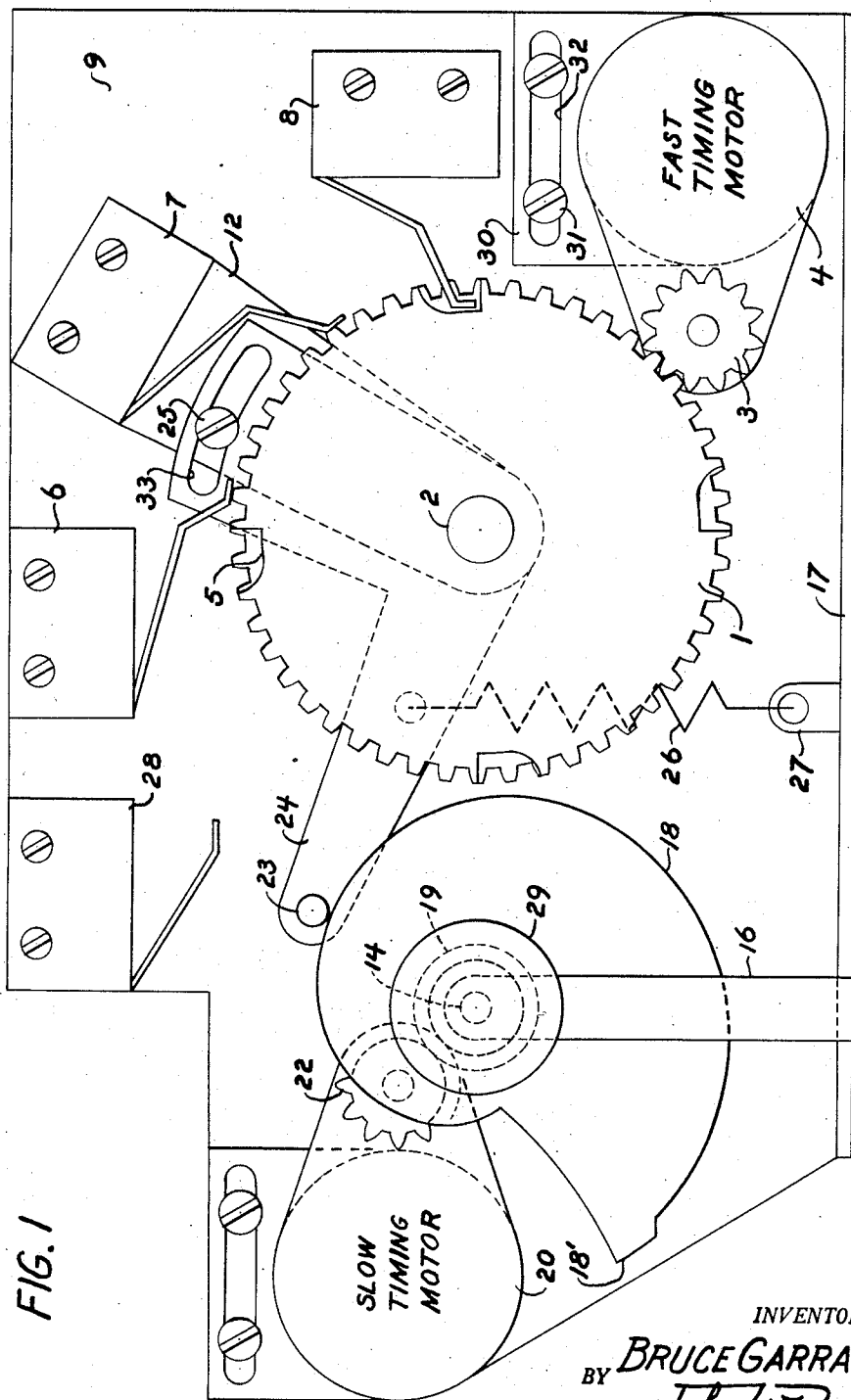


FIG. 1

INVENTOR.
BY **BRUCE GARRARD**
John W. Ralls
HIS ATTORNEY

Oct. 7, 1958

B. GARRARD

2,855,476

TIME SWITCH

Filed June 25, 1954

2 Sheets-Sheet 2

FIG. 2

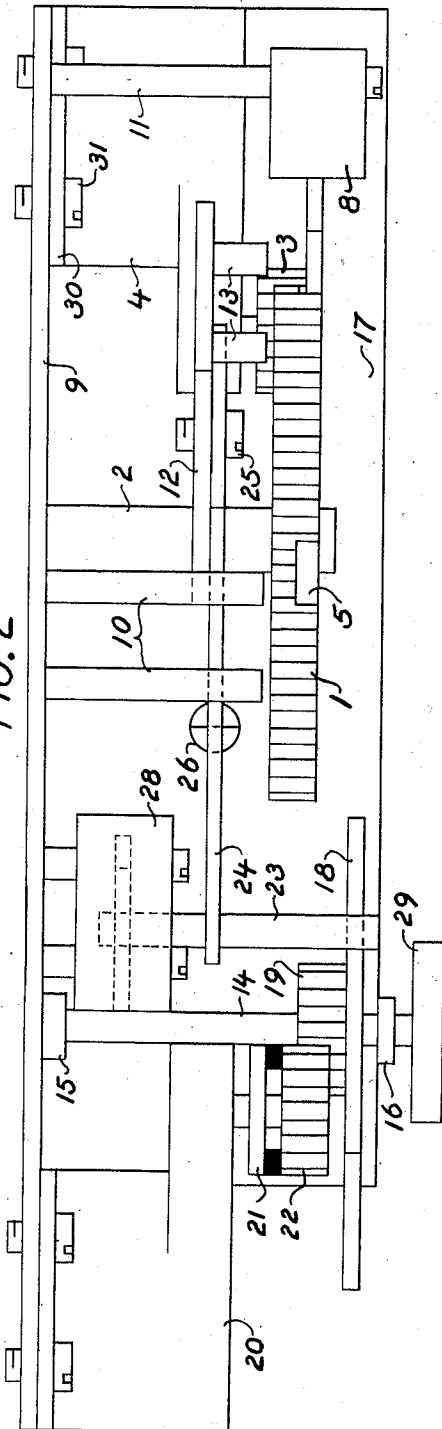
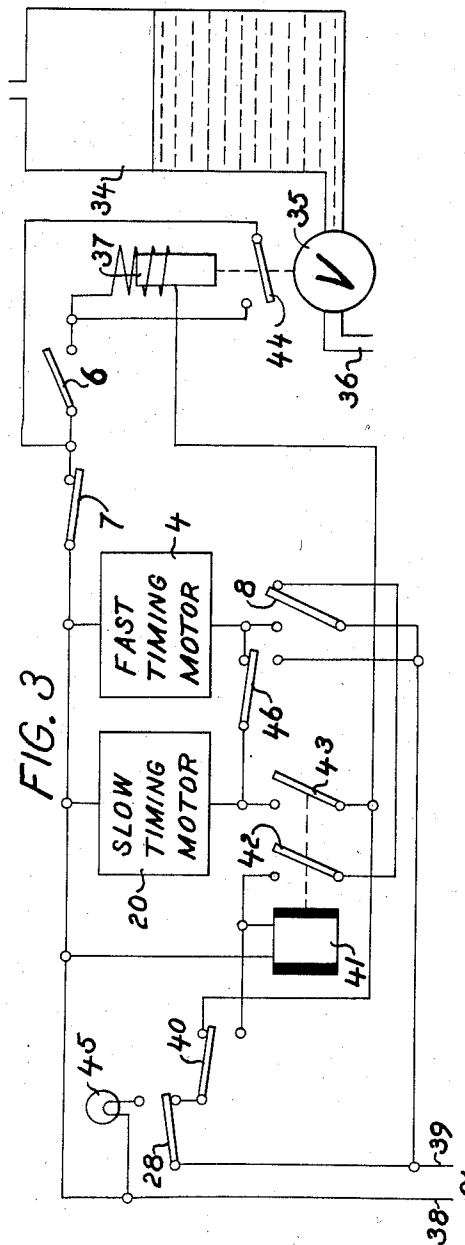


FIG. 3



INVENTOR.
BY **BRUCE GARRARD**
John W. Ralls
HIS ATTORNEY

1

2,855,476

TIME SWITCH

Bruce Garrard, Atlanta, Ga.

Application June 25, 1954, Serial No. 439,219

16 Claims. (Cl. 200—38)

This invention relates to time switches for controlling repetitive operations which require progressively varying time intervals.

It is sometimes desired, in certain types of coin-operated beverage dispensing machines, for example, to withdraw repetitively a fixed amount of liquid from a storage tank having an outlet through which the liquid may flow under the influence of gravity and having a valve for controlling such flow. When the tank is full, the desired amount of liquid can be withdrawn by opening the valve for a predetermined time interval. As the tank empties, the liquid flows through the outlet at a progressively slower rate. Consequently, if equal amounts of liquid are to be withdrawn at each operation, the valve must be opened for progressively increasing time intervals. A principal object of this invention is to provide an improved time switch for controlling the valve mechanism in such dispensing machines and for controlling other repetitive operations which require progressively varying time intervals. Other objects and advantages of the invention will appear as the description proceeds.

Briefly stated, in accordance with one aspect of the invention, a time switch of the type described has an actuator driven by a first timing motor, first and second switching mechanisms operated successively by motion of the actuator, and means driven by a second timing motor to move one of the switching mechanisms for progressively varying the time interval between the respective operations of the two switching mechanisms. When used to control a beverage dispensing machine, for example, operation of the first switching mechanism may open a valve to let liquid flow from a storage tank, and operation of the second switching mechanism may close the valve. Significant advantages accrue from the use of two separate timing motors, one to drive the actuator and one to drive the means for adjusting the time interval.

My invention will be better understood from the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims. In the drawings,

Fig. 1 is a front elevation of a time switch embodying principles of my invention,

Fig. 2 is a top view of the same time switch, with electrical switching mechanisms 6 and 7 removed, and

Fig. 3 is a schematic circuit diagram showing the time switch connected to control the withdrawal of liquid from a tank.

Referring now to Figs. 1 and 2 of the drawings, a circular actuator 1, having substantially the form of a spur gear, is rotated clockwise about a stationary shaft 2 by a pinion 3 driven by an electrical timing motor 4. The actuator 1 has four recesses 5 cut into its periphery and equally spaced apart thereon, as shown. The recesses 5 are cut into the front half only of the actuator, leaving gear teeth behind the recesses to engage pinion 3 as the actuator rotates.

2

Three electrical switches, 6, 7 and 8, are angularly spaced apart around the periphery of actuator 1, and are operated successively by each of the recesses 5 as the actuator rotates. These electrical switches are of a conventional type having switch arms, as shown, which ride upon the periphery of actuator 1 and successively drop into recesses 5 as the actuator rotates to operate the switches.

Switches 6 and 8 are fixed in position, and are attached to the stationary back plate 9 by screws extending into posts 10 and 11, respectively. Switch 7 is attached to a movable mounting bracket 12 by screws extending into posts 13. Bracket 12 is rotatable about shaft 2 to adjust the spacing between switches 6 and 7. This spacing determines the time interval between the respective operations of switches 6 and 7. Switch 8 controls the ending of each timing cycle. For each complete cycle of operation, actuator 1 rotates through one-quarter revolution, at the end of which the arm of switch 8 enters the next recess 5.

A rotatable shaft 14 is supported by a bushing 15 attached to back plate 9 and by a bracket 16 attached to stationary bottom plate 17. A cam 18 and a gear 19 are attached to and rotate with shaft 14. The shaft 14 and cam 18 are rotated counterclockwise by an electrical timing motor 20 through a friction clutch 21 and a gear 22 which engages gear 19, as shown. Motors 4 and 20 are preferably of a synchronous type and operate at a constant speed ratio; but motor 4 operates at a much faster speed so that cam 18 rotates by only a small fraction of a revolution each time that actuator 1 turns through one-quarter revolution to complete an operating cycle of switches 6, 7 and 8.

A cam follower 23 is attached to one end of an arm 24 which is rotatable about shaft 2. Arm 24 is attached to bracket 12 by a screw 25, so that arm 24 and bracket 12 rotate together. One end of a spring 26 is attached to arm 24, and the other end of the spring is attached to a lug 27 on the bottom plate 17, as shown. Spring 26 pulls arm 24 downward to keep cam follower 23 in engagement with the periphery of cam 18. As cam 18 rotates counterclockwise, cam follower 23 is forced upward by the cam, and bracket 12 with switch 7 is rotated clockwise about shaft 2. This increases the spacing between switches 6 and 7, and thus increases the time interval between the respective operations of these two switches.

The exact size and shape of cam 18 are determined by the requirements of each particular application. When a time switch is desired which may be used in a number of different applications, selectively, a number of interchangeable cams of different sizes and shapes may be provided, each cam being designed for a specific set of requirements. Also, the speed at which cam 18 rotates may be changed, either by changing the speed of motor 20 or by changing the ratio of gears 19 and 22. This might be done, for example, in adapting the time switch to control the withdrawal of liquid from storage tanks of different sizes.

In general, where a progressively increasing time interval is required, to control the withdrawal of liquid flowing from a tank under the influence of gravity, for example, a major portion of the cam 18 has a periphery of progressively increasing radius, as shown. When the tank is full, cam 18 is set to its position of minimum radius with respect to the point where cam follower 23 engages its periphery. This provides a minimum time interval between the respective operations of switches 6 and 7. During each cycle of operation, cam 18 is rotated counterclockwise a small fraction of a revolution, so that the time interval increases progressively as the tank empties.

A minor portion 18' of the cam has a periphery of substantially uniform greater radius. The cam position where cam follower 23 engages portion 18' is reached when the liquid storage tank is substantially empty. When cam follower 23 engages cam portion 18', the cam follower is forced upward the maximum amount and engages the arm of an electrical switch 28. The switch 28 is thereby operated, and it may be used to illuminate a signal lamp or to initiate any control action which may be desired when the tank is empty.

When the tank is refilled, cam 18 can be reset manually to its starting position by turning a knob 29 attached to the front of shaft 14. Friction clutch 21 permits this to be done without turning motor 20. The cam can also be reset by electrical means, as is hereinafter explained. The latter means of resetting is especially desirable when automatic refilling of the tank is provided, or when automatic control means are employed to switch to another full tank after the first tank is emptied.

An important advantage of my time switch is that the amount of liquid to be withdrawn from the tank at each operation can be changed without making any changes in cam 18 or its driving mechanism. For example, assume that it is desired to double the amount of liquid withdrawn at each operation. This can be done by replacing pinion 3 with a smaller pinion of such size that timing motor 4 rotates actuator 1 at one-half its former speed. This change doubles the time interval between the respective operations of switches 6 and 7, so that substantially twice as much liquid is withdrawn during each operation. The total cycle time during which actuator 1 is rotated one-quarter revolution is also doubled, and since timing motor 20 rotates cam 18 at the same speed as before, cam 18 rotates during each cycle through twice as large an angle as was previously the case, so that the changes in position of cam 18 continue to be correctly related to the changes in liquid level within the storage tank. Consequently, once the correct size, shape and speed of cam 18 have been selected for a storage tank of given size and shape, no changes in the cam design are required when changes are made in the quantity of liquid withdrawn at each operation.

To facilitate changing pinion 3, motor 4 is mounted on a bracket 30 attached to back plate 9 by screws 31 which extend through a slot 32 in bracket 30. By loosening screws 31, motor 4 can be moved closer to or farther from actuator 1, selectively, to accommodate pinions of different sizes.

An alternative way to change the amount of liquid withdrawn at each operation is to make motor 4 a two-speed or multi-speed motor, so that the speed of actuator 1 can be changed by electrical means whenever desired, without changing pinion 3. Another alternative is to use two timing motors operable selectively to rotate actuator 1 at either of two different speeds. As one example of how such electrical speed-changing means may be useful, assume that a beverage dispensing machine is required to deliver a small amount of beverage upon the insertion of ten cents, and a larger amount of beverage upon the insertion of fifteen cents. One electrical circuit, energized by the coin mechanism of the dispensing machine upon the receipt of ten cents, causes the timing motor to rotate actuator 1 at a relatively fast speed to deliver a small amount of beverage. Another electrical circuit, energized by the coin mechanism upon the receipt of fifteen cents, causes the same or another timing motor to rotate actuator 1 at a somewhat slower speed to deliver a larger amount of beverage. Since cam 18 is rotated by a separate timing motor of its own, as previously explained, the cam position is always changed in correct proportion to changes in the level of liquid remaining in the storage tank, despite the fact that different amounts of liquid may be withdrawn at different times.

Screw 25 extends through a slot 33 in arm 24 into a threaded hole in bracket 12. To adjust the initial time in-

terval between the respective operations of switches 6 and 7 when the liquid storage tank is full, screw 25 is loosened and bracket 12 is adjusted to the correct position while cam follower 23 engages the periphery of cam 18 at its point of minimum radius. Screw 25 is then tightened, and thereafter bracket 12 and arm 23 move together as a single unit about shaft 2 to increase the time interval between the switch operations as cam 18 rotates in correspondence with changes in the liquid level within the storage tank.

Fig. 3 shows a circuit using my time switch to control the withdrawal of liquid from a storage tank 34. When valve 35 is opened, liquid flows under the influence of gravity from tank 34 through an outlet 36. Valve 35 is normally closed, but it may be opened when desired by supplying electric current to energize a valve-operating solenoid 37.

Electric power from any suitable source is supplied through leads 38 and 39. To withdraw a fixed amount of liquid from the tank, a switch 40, biased to the raised position shown, is closed downward momentarily to complete a circuit which energizes a relay 41. In a coin-operated dispensing machine, switch 40 may be a part of the conventional coin-receiving mechanism. A holding contact 42 keeps relay 41 energized after switch 40 returns to its initial raised position. Now a circuit is completed through relay contact 43 which supplies electric power to operate the timing motors 4 and 20 simultaneously. Motor 4 rotates actuator 1 at a relatively fast speed, and motor 20 rotates cam 18 at a relatively slow speed, as hereinbefore explained. When actuator 1 has been rotated sufficiently to move the arm of switch 8 out of the actuator recess, switch 8 is operated to the left from its initial position shown in Fig. 3, and the holding circuit of relay 41 is broken, whereupon the relay is deenergized and relay contacts 42 and 43 open. At the same time, another circuit is completed through switch 8 which supplies electric power to motors 4 and 20, so that the two timing motors continue to operate.

When the arm of switch 6 enters recess 5, switch 6 closes and completes a circuit which energizes solenoid 37 to open valve 35 and start the flow of liquid through outlet 36. Upon further rotation of actuator 1, switch 6 reopens, but solenoid 37 is kept energized by a holding contact 44. After a time interval which depends upon the spacing between switches 6 and 7, the arm of switch 7 enters recess 5 and switch 7 opens. This breaks the circuit to solenoid 37, and deenergizes the solenoid to close valve 35 and stop the flow of liquid through outlet 36. Motors 4 and 20 continue to operate until actuator 1 has completed one-quarter revolution, whereupon the arm of switch 8 enters the next recess 5. All of the switches are now back in their initial positions shown in Fig. 3, and no further operation occurs until switch 40 is again closed downward.

When substantially all of the liquid has been withdrawn from tank 34, cam 18 has rotated to a position where cam follower 23 engages the cam portion 18' having the greatest radius. The cam follower is raised by cam portion 18' sufficiently to operate switch 28, which completes an electric circuit to illuminate the signal lamp 45 and at the same time opens the circuits to motor 4, solenoid 37 and relay 41. When the tank 34 is refilled, cam 18 must be reset to its initial position. This can be done by closing a switch 46 downward, which completes a circuit to operate motor 20 without operating motor 4. As motor 20 operates, cam 18 continues its counterclockwise rotation until cam portion 18' moves out of engagement with cam follower 23, whereupon the cam follower is moved downward by spring 26 into engagement with the minimum-radius portion of cam 18. Now switch 28 returns to its initial position, lamp 45 is extinguished, and switch 46 may be closed upward to restore the circuit to its initial conditions.

Cam 18 rotates continuously in the same direction as

long as motor 20 operates, and no reverse rotation of the cam is required for resetting purposes. The provisions for operating motor 20 without operating motor 4 prevent undesirable operations of valve 35 during the resetting operation. Since the resetting operation may be accomplished wholly by electrical means, my time switch is well suited to applications where means are provided for refilling tank 34 automatically, or for transferring automatically to another tank when the first tank has been emptied.

My invention is not limited to the specific embodiment herein illustrated and described. The following claims are intended to cover all changes and modifications which do not depart from the true spirit and scope of the invention.

I claim:

1. A time switch comprising an actuator, a first timing motor operable to move said actuator at a constant speed and in repetitive cycles, first and second switch mechanisms successively operated by movement of said actuator through one of said cycles, and means including a second timing motor operable to vary progressively the time interval between the respective operations of said first and second switch mechanisms.

2. A time switch comprising a rotatable actuator, a first timing motor operable to rotate said actuator, first and second switch mechanisms angularly spaced apart with respect to the actuator axis and successively operated by rotation of said actuator, and means including a second timing motor operable to move one of said switch mechanisms around the axis of said actuator to vary the angular spacing between said first and second switch mechanisms, whereby the time interval between the respective operations of said first and second switch mechanisms is varied progressively.

3. A time switch comprising a rotatable actuator having at least one recess in its periphery, a first timing motor operable to rotate said actuator, first and second electrical switches spaced apart around the periphery of said actuator and operated successively by said recess as said actuator rotates, a mounting bracket for one of said electrical switches rotatable about the axis of said actuator, and means including a second timing motor operable to rotate said bracket to vary the spacing between said electrical switches, whereby the time interval between the respective operations of said first and second electrical switches is varied progressively.

4. A time switch comprising a rotatable circular actuator having a plurality of recesses equally spaced apart around its periphery, a first timing motor operable to rotate said actuator, first, second and third electrical switches spaced apart around the periphery of said actuator and operated successively by said recesses as said actuator rotates, circuit means operable to start said first timing motor, circuit means stopping said first timing motor upon operation of said third electrical switch, a mounting bracket for said second electrical switch rotatable about the axis of said actuator, and means including a second timing motor operable to rotate said bracket to vary the spacing between said first and second electrical switches, whereby the time interval between the respective operations of said first and second electrical switches is varied progressively.

5. A time switch comprising an actuator, a first timing motor operable to move said actuator, first and second switch mechanisms successively operated by movement of said actuator, a rotatable cam, a second timing motor operable to rotate said cam, and cam follower means moving one of said switch mechanisms upon rotation of said cam to vary progressively the time interval between the respective operations of said first and second switch mechanisms.

6. A time switch comprising a rotatable actuator, a first timing motor operable to rotate said actuator, first and second electrical switches angularly spaced apart with respect to the actuator axis and successively operated by

rotation of said actuator, a mounting bracket for one of said electrical switches rotatable about said actuator axis to vary the angular spacing between said first and second electrical switches, a rotatable cam, a second timing motor operable to rotate said cam, and a cam follower rotating said bracket upon rotation of said cam, whereby the time interval between the respective operations of said first and second electrical switches is varied progressively.

7. A time switch comprising an actuator, a first timing motor operable to move said actuator, first and second switch mechanisms successively operated by movement of said actuator, means including a second timing motor operable to vary progressively the time interval between the respective operations of said first and second switch mechanisms, circuit means for operating said first and second timing motors simultaneously, and circuit means for operating said second timing motor without operating said first timing motor.

8. A time switch comprising an actuator, a first timing motor operable to move said actuator, first and second switch mechanisms successively operated by movement of said actuator, a continuously rotatable cam, a second timing motor operable to rotate said cam, cam follower means moving one of said first and second switch mechanisms upon rotation of said cam to vary progressively the time interval between the respective operations of said first and second switch mechanisms, and an additional switch mechanism operated upon each complete rotation of said cam.

9. A time switch comprising an actuator, means operable to move said actuator, first and second switch mechanisms successively operated by movement of said actuator, a cam, means operable to move said cam simultaneously with the movement of said actuator, cam follower means moving one of said switch mechanisms upon movement of said cam to vary progressively the time interval between the respective operations of said first and second switch mechanisms, and means for changing the speed at which said actuator is moved without changing the speed at which said cam is moved.

10. A time switch comprising an actuator, means operable to move said actuator, first and second switch mechanisms successively operated by movement of said actuator, a cam, means operable to move said cam simultaneously with the movement of said actuator, cam follower means moving one of said switch mechanisms upon movement of said cam to vary progressively the time interval between the respective operations of said first and second switch mechanisms, and means for changing the speed at which said cam is moved without changing the speed at which said actuator is moved.

11. A time switch comprising an actuator, a first timing motor operable to move said actuator, first and second switch mechanisms spaced apart and successively operated by movement of said actuator, a rotatable cam, a major portion of said cam having a periphery of progressively increasing radius, a minor portion of said cam having a periphery of substantially uniform greater radius, a second timing motor operable to rotate said cam, cam follower means engaging the periphery of said cam and progressively increasing the spacing between said first and second switch mechanisms as said cam rotates to positions of progressively increasing radius, whereby the time interval between the respective operations of said first and second switch mechanisms is progressively increased, and an additional switch mechanism operated by said cam follower means upon rotation of said cam to said minor portion having a periphery of substantially uniform greater radius.

12. A time switch comprising a rotatable circular actuator having a plurality of recesses equally spaced apart around its periphery, a first timing motor operable to rotate said actuator at a relatively fast speed, first, second and third electrical switches spaced apart around the periphery of said actuator and operated successively by

said recesses as said actuator rotates, circuit means operable to start said first timing motor, circuit means stopping said first timing motor upon operation of said third electrical switch, a mounting bracket for said second electrical switch rotatable about the axis of said actuator to vary the spacing between said first and second electrical switches, a continuously rotatable cam, a major portion of said cam having a periphery of progressively increasing radius, a minor portion of said cam having a periphery of substantially uniform radius greater than the largest radius of said major portion, a second timing motor operable to rotate said cam at a relatively slow speed, cam follower means engaging the periphery of said cam and rotating said bracket to increase progressively the spacing between said first and second electrical switches as said cam rotates to positions of progressively increasing radius with respect to the point of engagement of said cam follower, whereby the time interval between the respective operations of said first and second electrical switches is progressively increased, an additional electrical switch operated by said cam follower means upon rotation of said cam to a position where said cam follower engages said minor portion of said cam, circuit means for operating said second timing motor simultaneously with operation of said first timing motor, circuit means for operating said second timing motor without operating said first timing motor, means for changing the speed at which said actuator is moved without changing the speed at which said cam is moved, and means for changing the speed at which said actuator is moved.

13. A time switch comprising an actuator, a motor operable to move said actuator at a constant rate of speed and in repetitive cycles, first and second switch mechanisms successively operated by movement of said actuator through one of said cycles, and means including a motor operable automatically to vary the time interval between the respective operations of said first and second switch mechanisms from one amount during one of said cycles to a different amount during the next of said cycles.

14. A time switch comprising an actuator, means engaging said actuator to move said actuator at a constant rate of speed from a start position to a stop position,

first and second switch mechanisms successively operated by movement of said actuator, one of said switch mechanisms being movable relative to the other of said switch mechanisms, and means operable automatically to move one of said switch mechanisms relative to the other of said switch mechanisms during movement of said actuator from said start position to said stop position.

15. A time switch comprising a rotatable actuator having at least one switch actuating means, a motor operable to rotate said actuator at a constant rate of speed, first and second switch mechanisms spaced apart around the path of said switch actuating means and operated successively by said switch actuating means as said actuator rotates, a mounting bracket for one of said switch mechanisms rotatable about the axis of said actuator, and means including a motor operable to rotate said bracket to vary the spacing between said switch mechanisms, whereby the time interval between the respective operations of said first and second switch mechanisms is varied according to a chosen pattern.

16. A time switch comprising an actuator, a first electrical timing motor operable to move said actuator at a constant rate of speed and in repetitive cycles, first and second switch mechanisms operated by movement of said actuator through one of said cycles, a second electrical timing motor, and means operated by said second electrical timing motor to vary the time interval between the respective operations of said first and second switch mechanisms from a first amount of time during one of said cycles to succeeding amounts during the next succeeding ones of said cycles, said succeeding amounts varying according to a non-linear pattern.

References Cited in the file of this patent

UNITED STATES PATENTS

1,468,801	Clark	Sept. 25, 1923
1,639,679	Zsoldos	Aug. 23, 1927
2,338,305	Simmon	Jan. 4, 1944
2,386,760	Warner	Oct. 16, 1945
2,439,842	Clark	Apr. 20, 1948
2,454,882	Oakley	Nov. 30, 1948
2,578,824	Morrison	Dec. 18, 1951
2,675,456	Cleminson	Apr. 13, 1954