March 13, 1962 C. J. GOODHOUSE ETAL 3,025,365

PUSHBUTTON TIMING DEVICE

Filed April 13, 1960

2 Sheets-Sheet 1

Fig. 1.

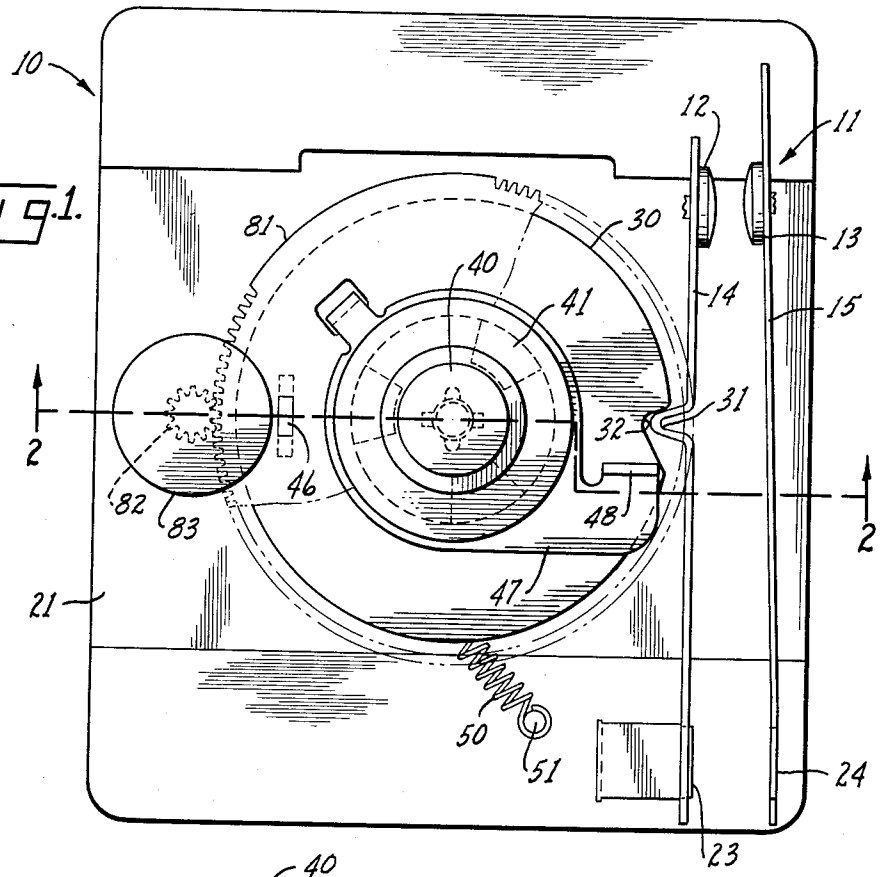


Fig. 3.

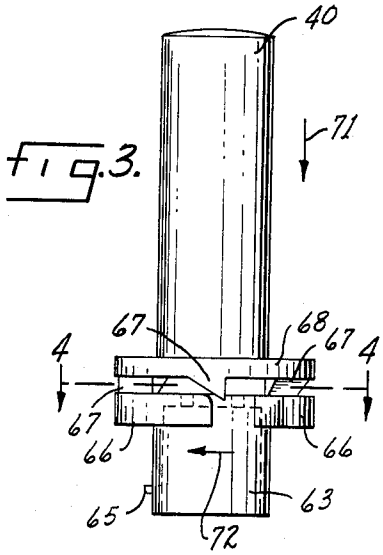
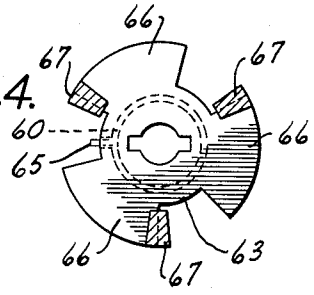


Fig. 4.



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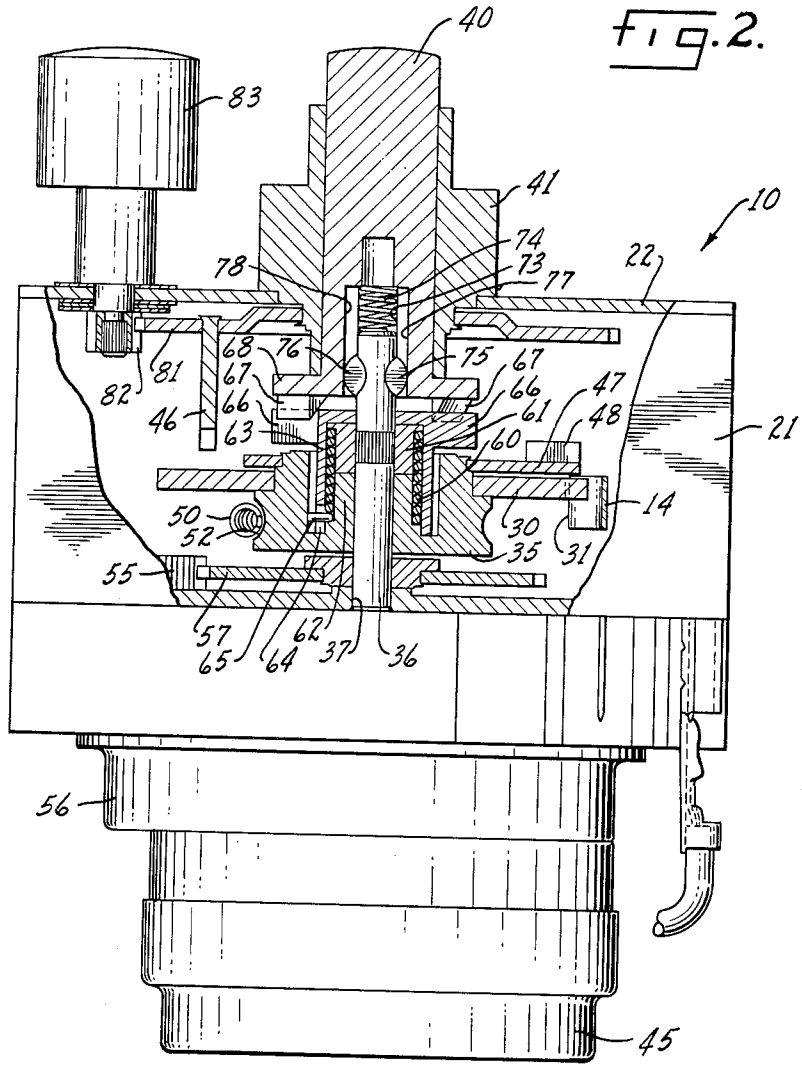
2 Sheets-Sheet 2

Fig. 2.



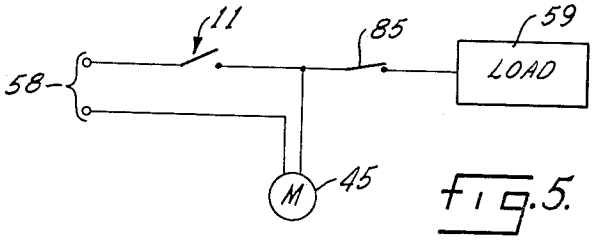


Fig. 5.

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PUSHBUTTON TIMING DEVICE

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Filed Apr. 13, 1960, Ser. No. 21,992
7 Claims. (Cl. 200—33)

This invention relates to timing devices which control an electrical circuit and concerns more particularly a pushbutton operated timer for operating a switch during a predetermined time interval.

A wide variety of electrical equipment, from X-ray machines to hot-air hand dryers, is intended to function for discrete, predetermined timed intervals each time they are operated. It is to control such devices that a timer of the present invention is primarily intended.

An object of the invention is to provide a novel switch-controlling timer that can be set with considerable accuracy to operate a switch throughout a time interval of exactly the desired duration.

Another object of the invention is to provide a novel timer of the above type that is pushbutton operated to begin the timing cycle and which responds to a very light pressure on the pushbutton operator.

It is also an object to provide a timer which can be returned to the starting position of the timing cycle at any time during that cycle so that the switch operating interval can be easily extended as desired.

It is a further object to provide a novel timer having the above characteristics that is unusually compact.

Moreover, it is an object to provide a timer as described above that is accurate and reliable, while being simple in design and hence economical to manufacture.

In one of its aspects, it is an object of the invention to provide a simple, reliable and easily operated clutch particularly well suited for timers of the above type.

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIGURE 1 is a plan view of a timing device constructed in accordance with the invention and shown with certain parts broken away or in phantom for clarity of illustration;

FIG. 2 is a section taken approximately along the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary elevation showing certain of the parts appearing in section in FIG. 2;

FIG. 4 is a section taken approximately along the line 4—4 of FIG. 3; and

FIG. 5 is a schematic diagram of the electrical circuit embodied in the timer shown in FIG. 1.

While the invention will be described in connection with a preferred embodiment, it will be understood that I do not intend to limit the invention to that embodiment. On the contrary, I intend to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.

Turning now to the drawings, there is shown a timing device 10 embodying the invention and arranged to operate a switch 11. The switch 11 includes contacts 12 and 13 mounted on resilient contact arms 14 and 15 respectively. In the illustrated embodiment, the switch 11 is normally open and therefore, in operating the switch, the contacts 12 and 13 are closed by the timer 10.

The timer includes a frame made up of a cup-like body or housing 21 and a cover plate 22. The cover plate appears in FIG. 2, but has been removed so as to show the underlying parts in FIG. 1. The contact arms 14 and 15 of the switch 11 are anchored at 23 and 24 respectively, to the body 21 of the timer.

For operating the switch 11, the timer is provided with a rotatable cam 30 formed to cooperate with an operator portion 31 which is a part of the contact arm 14. In the illustrated construction, a notch 32 is formed in the periphery of the otherwise circular cam 30 and the operator portion 31 takes the form of an elbow bend in the resilient arm 14. The contact arm 14 is mounted at 23 so that its operator portion 31 is resiliently biased against the periphery of the cam 30.

The rest position of the cam 30 is established with the portion 31 being received within the notch 32, as shown in FIG. 1. At any other angular position of the cam 30, it will be understood that the operator portion 31 is lifted from the notch 32 onto the periphery of the cam 30 so that the resilient contact arm 14 is urged to the right in FIG. 1 to close the contacts 12, 13 and thus operate the switch 11.

To rotatably mount the cam 30, the cam is secured to a hub 35 that is journaled on a main shaft 36. One end of the shaft 36 is journaled at 37 in the body 21 of the timer and the other end of the shaft is carried by a pushbutton operator 40, to which later reference will be made, that is rotatably supported in a bushing 41 mounted in the timer cover plate 22. The hub 35, and thus the cam 30, is free to rotate on the shaft 36 and the shaft 36 is likewise rotatably supported in the timer assembly.

In carrying out the invention, the cam 30 is adapted to be snapped from its rest position, in which the switch 11 is not operated, to a starting position, operating the switch, from which the cam is returned to its rest position by a timing motor 45. The timing motor drives the cam 30 from its starting position to its rest position during a predetermined time interval and hence the switch 11 remains operated for that interval.

In order to establish a starting position for the cam 30, a stop 46 is mounted on the timer frame cover plate 22 and a cooperating stop arm 47 is secured to the cam hub 35. The arm 47 is formed with a flange 48 which, upon swinging of the hub 35 and the cam 30, moves into abutment with the stop 46 preventing further rotation of the cam and hence establishing the starting position. To snap the cam 30 from its rest to its starting position, the cam is biased by a tensioned helical spring 50 in a counterclockwise direction as seen in FIG. 1. The spring is anchored by a pin 51 to the body 21 of the timer and is wound partially about the cam hub 35 within an annular groove 52, ending in a point of securement to the stop arm 47.

In order to return the cam 30 from its starting position with the flange 48 abutting the stop 46 under the urging of the spring 50, to its rest position wherein the switch operator portion 31 is received within the cam notch 32, the timing motor 45 is coupled to the main shaft 36 and the shaft is clutched to the cam hub 35. In the illustrated embodiment, the timing motor 45 is a conventional, shaded pole, synchronous motor driving a pinion 55 through speed reducing gears located in a gear case 56. The pinion 55 is in meshing engagement with a gear wheel 57 secured to the shaft 36. Energization of the motor 45 drives the shaft 36 in a clockwise direction as seen in FIG. 1.

The motor is arranged so as to be energized whenever the cam 30 is swung from its rest position. In the illustrated arrangement, the timer is connected between a source of current 58 and a load 59 and the motor 45 is electrically coupled in parallel with the switch 11. Thus, whenever the cam 30 is swung from its rest position so as to operate the switch and supply power to the load 59, the motor 45 is also energized to drive the cam 30 back to its rest position.

In accordance with the present invention, the timing motor 45 is clutched to the control cam 30 by a coil spring

clutch element 60 that is coupled to the pushbutton operator 40 so as to be instantly releasable. In the illustrated embodiment, the coil spring clutch element 60 is wound closely about adjacent cylindrical portions on a collar 61 secured to the shaft 36 and an undercut shoulder 62 forming a portion of the cam hub 35. The element 60 is wound so as to lock the cam hub 35 to the collar 61 against the biasing force of the tensioned spring 50 and thus to permit the shaft 36 to drive the cam 30 clockwise from its starting position to its rest position.

For the purpose of releasing the clutch spring element 60 upon depression of the pushbutton operator 40, a sleeve 63 is fitted loosely about the spring clutch element 60 and is provided with a notch 64 at its lower end which receives an out-turned end 65 of the spring clutch element. The sleeve 63 is formed with a plurality of radially extending arms 66 which cooperate with arms 67 depending from a flange 68 formed as a portion of the pushbutton operator 40. The engaging portions of the arms 66 and 67 are cam-shaped so that movement of the pushbutton operator 40 in the direction of the arrow 71 in FIG. 3 causes clockwise rotation of the sleeve 63 in the direction of the arrow 72 in that figure.

To allow movement of the pushbutton operator 40 in the direction of the arrow 71, the operator is slidably received in the bushing 41 and the shaft 36 is slidably received in a cylindrical opening 73 formed in the operator 40. A compressed helical spring 74 holds the pushbutton operator in its normally elevated position.

It can now be seen that depression of the pushbutton operator 40 against the light resistance of the spring 74 causes the arms 67 on the operator flange 68 to cam the sleeve arms 66 so as to slightly rotate the sleeve 63. Rotation of the sleeve 63 moves the end 65 of the coil spring clutch element 60 slightly in a clockwise direction tending to unwind the spring element 60. This relieves the gripping engagement of the clutch spring element 60 about the shoulder portion 62 of the cam hub 35 and thus frees the cam 30 for rotation in a counterclockwise direction under the urging of the spring 50. Upon release of the pushbutton operator 40, the spring 74 lifts the arms 67 from camming engagement with the arms 66 and allows the coil spring clutch element 60 to again grip the adjacent cylindrical portions of the collar 61 and shoulder 62.

As a feature of the invention, the clutch spring arms 66 and 67 are rotatably coupled so that the clutch spring can be released at any point during the timing cycle. The arms 66 are carried by the sleeve 63 which is locked against rotation to the collar 61, and thus to the shaft 36, by the coil spring clutch element 60. The arms 67 are carried by the pushbutton operator 40 which is locked against rotation to the shaft 36 by swaged portions 75 and 76 of the shaft 36 which are received by slots 77, 78 respectively, formed in the pushbutton operator 40. Thus, both sets of arms 66 and 67 are rotatably coupled to the main shaft 36, and hence these arms remain in the same relative positions in all angular positions of the shaft 36. It is therefore possible at any time during the timing cycle to again depress the pushbutton operator 40 so as to release the coil spring clutch element 60 and cause the cam 30 to be swung back to its starting position. The timing cycle of the timer 10 can thus be lengthened even while in progress.

In the preferred embodiment, the stop 46 is adjustably mounted so that the timing interval during which the switch 11 is operated can be selected. In the illustrated construction, the stop 46 is secured to a gear wheel 81 carried by the bushing 41, and the bushing is rotatably supported in the cover plate 22. To rotate the gear wheel 81 and thus adjust the angular position of the stop 46, a pinion 82 is journaled in the cover plate 22 and is coupled to a knob 83. It will thus be apparent that rotation of the knob 83 causes the pinion 82 to rotate the gear wheel 81 so as to vary the angular position of the stop 46 about the shaft 36. Of course the greater the angular distance between the switch operator portion 31 and the stop 46, the greater will be the interval during which the switch 11 is operated when the pushbutton operator 40 is depressed. If desired, suitable indicia marks can be placed on the cover plate 22 and the gear wheel 81 to indicate the setting of the stop 46 in terms of the switch operating intervals that correspond to particular settings of the stop 46.

To summarize the operation of the timer 10, the knob 83 is first manipulated to set the stop 46 at a desired angular relationship with respect to the switch operator portion 32. When it is desired to supply current from the source 58 to the load 59 for the time interval predetermined by the setting of the stop 46, the pushbutton operator 40 is depressed. Downward movement of the arms 67 on the pushbutton operator 40 cams the arms 66 of the sleeve 63 so as to rotate the sleeve in a clockwise direction and thus slightly unwind the coil spring clutch element 60 from about the shoulder portion 62 of the cam hub 35. Upon release of the cam hub 35 by the slight unwinding of the coil clutch spring element 60, the cam 30 is freed and rotates under the urging of the tensioned spring 50 from its rest position in a counterclockwise direction until the flange 48 on the stop arm 47 abuts the stop 46. Because of the force of the tensioned spring 50, the cam 30 snaps from its rest to its starting position substantially instantaneously. Following depression and release of the pushbutton operator 40, the spring 74 lifts the arms 67 from camming engagement with the arms 66 and the coil spring clutch element 60 is allowed to again grip the shoulder portion 62 of the cam hub 35.

As soon as the cam 30 swings from its rest position, the switch operator portion 31 rides up onto the periphery of the cam so as to operate the switch 11 by closing the contacts 12, 13. This transmits electrical energy from the source 58 to the load 59 and also energizes the motor 45. Energization of the motor 45 drives the shaft 36, through the pinion 55 and the gear wheel 57, so as to rotate the collar 61 in a clockwise direction. Rotation of the collar 61 tends to further tighten the coil spring clutch element 60 and thus a driving force is imparted to the cam hub 35 with the result that the cam 30 is slowly driven, by the timing motor, in a clockwise direction from its starting position back to its rest position. During the time interval required by the timing motor to return the cam to its rest position, the switch 11 remains operated. As the cam reaches its rest position the switch operator potrion 31 again falls into the cam notch 32 so as to open the contacts 12, 13 and cease operation of the switch 11. Opening of the contacts interrupts the supply of electrical current to the load 59 and also deenergizes the motor 45. Since rotation of the cam hub 35 in a clockwise direction again tensions the spring 50, the timer is, at the completion of its timing cycle, again conditioned for another cycle of operation.

Since the arms 66 and 67 are kept in the same relative positions during rotation of the shaft 36, it will be understood that the pushbutton operator 40 can be depressed to again start the cycle at any time during the timing cycle. If the operator is so depressed, the coil spring clutch element 60 is again released in the manner described above and the cam 30 is swung by the spring 50 back to its starting position with the flange 48 in engagement with the stop 46. In this way the timing cycle can be lengthened at will. In order to cut short the timing cycle at any desired point, a switch 85 is interposed between the timer and the load 59 and it will be appreciated that upon opening of the switch 85 energization of the load 59 will be discontinued while the timer completes its operating cycle. Alternatively, the timing cycle can be cut short by simply rotating the knob 83 until the stop 46 engages the flange 48 and carries the cam clockwise to its rest position, thereby operating the switch 11 and ending the cycle. This, in effect, is setting the timer 10 for a zero timing cycle. The cam 30 can be easily rotated more rapidly by swinging the stop 46 against the

flange 48 than the cam is drawn by the collar 61 since the hub shoulder portion 62 simply overruns within the coil clutch spring element 60. The timing cycle during which current is supplied to the load 59 is thus quite flexible and can not only be predetermined by setting the stop 46, but can also be lengthened or shortened at will by operating the switch 85 or the knob 83 and the operator 40.

It will be understood that the coil spring clutch element 60 tightly locks the collar 61 and the shoulder portion 62 together in any relative angular position of these elements. That is, after the element 60 is slightly unwound so as to release and unlock the shoulder portion 62, immediately upon freeing the element 60 after the collar 61 and the shoulder portion 62 are angularly adjusted, the element 60 again grips the shoulder portion 62 to lock the hub 35 to the collar 61 without further shifting of the relative angular positions of the collar 61 and the shoulder portion 62. There is no incremental shifting of the parts as would be caused by the interfitting of conventional clutch elements. As a result, the timer 10 can be set to operate for very accurately predetermined time intervals. Depression of the pushbutton operator 40 results in instantaneous unlocking of the cam 30, and release of the operator 40 causes immediate positive locking of the cam to the main shaft 36 in any angular position of the cam.

Those skilled in the art will also note that substantially all of the operative parts making up the timer 10 are mounted on the single main shaft 36 so that the timer assembly is unusually compact. It will also be appreciated that the construction of the timer 10 is quite simple and hence the timer is economical to manufacture and quite reliable in operation.

We claim as our invention:

1. A timing device for controlling a switch operator, comprising, in combination, a main shaft, a control cam journaled on said shaft, an operator riding on said control cam, said cam being formed so as to operate said operator whenever the cam is swung from its rest position, means biasing said cam in one direction from said rest position, a timing motor coupled to said shaft for driving said shaft in a direction opposite to said one direction, a coil spring clutch element wound closely around adjacent cylindrical portions on both said cam and said shaft so that the cam is locked to the shaft against said biasing force and the shaft can drive the cam against the bias, a collar surrounding said spring and coupled to one end thereof, means for rotating said collar in a direction to unwind said spring and thus unlock said cam, a stop to limit rotation of said biased cam from said rest position when it is unlocked from said shaft, and means for energizing said motor whenever said cam is out of said rest position so as to return the cam to its rest position during a time interval predetermined by the position of said stop.

2. A timing device for controlling a switch operator, comprising, in combination, a main shaft, a control cam journaled on said shaft, an operator riding on said control cam, said cam being formed so as to operate said operator whenever the cam is swung from its rest position, means biasing said cam in one direction from said rest position, a timing motor coupled to said shaft for driving said shaft in a direction opposite to said one direction, a coil spring clutch element wound closely around adjacent cylindrical portions on both said cam and said shaft so that the cam is locked to the shaft against said baising force and the shaft can drive the cam against the bias, a collar surrounding said spring and coupled to one end thereof, a pushbutton slidably mounted on said shaft, said pushbutton and said collar having adjacent portions formed with cooperating cam surfaces so that depression of the button rotates the collar in a direction to unwind said spring and thus unlock said cam, a stop to limit rotation of said biased cam from said rest position when it is unlocked from said shaft, means for energizing said motor whenever said cam is out of said rest position so as to return the cam to its rest position during a time interval predetermined by the position of said stop, and means for adjustably varying the position of said stop so as to selectively control said time interval.

3. A timing device for controlling a switch operator, comprising, in combination, a main shaft, a control cam journaled on said shaft, an operator riding on said control cam, said cam being formed so as to operate said operator whenever the cam is swung from its rest position, means biasing said cam in one direction from said rest position, a timing motor coupled to said shaft for driving said shaft in a direction opposite to said one direction, a coil spring clutch element wound closely around adjacent cylindrical portions on both said cam and said shaft so that the cam is locked to the shaft against said biasing force and the shaft can drive the cam against the bias, a collar surrounding said spring and coupled to one end thereof, a pushbutton slidably mounted on said shaft, said pushbutton and said collar having adjacent portions formed with cooperating cam surfaces so that depression of the button rotates the collar in a direction to unwind said spring and thus unlock said cam, a stop to limit rotation of said biased cam from said rest position when it is unlocked from said shaft, and means for energizing said motor whenever said cam is out of said rest position so as to return the cam to its rest position during a time interval predetermined by the position of said stop, said pushbutton and said sleeve being each rotatably coupled to said main shaft so as to remain in the same relative positions during operation of said motor and thus allow depression of said pushbutton and unlocking of said cam during said time interval.

4. A timing device for controlling a switch operator, comprising, in combination, a control cam, an operator riding on said control cam, said cam being formed so as to operate said operator whenever the cam is moved from its rest position, means biasing said cam in one direction from said rest position, a timing motor for driving said cam in a direction opposite to said one direction, a coil spring clutch element wound closely around a cylindrical portion on said cam so that the cam is locked against said biasing force, a slidably mounted pushbutton, means coupling said pushbutton and said spring so that depression of the button unwinds said spring and thus unlocks said cam, a stop to limit rotation of said biased cam from said rest position when it is unlocked, and means for energizing said motor whenever said cam is out of said rest position so as to return the cam to its rest position during a time interval predetermined by the position of said stop.

5. A timing device for controlling a switch operator, comprising, in combination, a control cam, an operator riding on said control cam, said cam being formed so as to operate said operator whenever the cam is moved from its rest position, means biasing said cam in one direction from said rest position, a timing motor for driving said cam in a direction opposite to said one direction, a coil spring clutch element wound closely around a cylindrical portion on said cam so that the cam is locked against said biasing force, a slidably mounted pushbutton, means coupling said pushbutton and said spring so that depression of the button unwinds said spring and thus unlocks said cam, a stop to limit rotation of said biased cam from said rest position when it is unlocked, and means for energizing said motor whenever said cam is out of said rest position so as to return the cam to its rest position during a time interval predetermined by the position of said stop, said pushbutton and said spring being each rotatively coupled so as to remain in the same relative positions during operation of said

motor and thus allow depression of said pushbutton and unlocking of said cam during said time interval.

6. In a timing device including a driving train for selectively transmitting rotary movement from a timing motor, the combination comprising a frame, a shaft forming a part of said driving train and being journalled in said frame, a sleeve journalled on said shaft, a coil spring clutch element wound closely around adjacent cylindrical portions on both said shaft and said sleeve so that the sleeve and shaft are locked for simultaneous rotation in one direction, an annular collar surrounding said spring and being coupled to one end thereof, an operator axially alined with said collar slidably mounted in said frame for reciprocating movement toward and away from said collar, and means coupling said operator and said collar for rotating the latter in a direction to unwind said spring upon sliding movement of said operator.

7. In a timing device including a driving train for

selectively transmitting rotary movement from a timing motor, the combination comprising a frame, a shaft forming a part of said driving train and being journalled in said frame, a sleeve journalled on said shaft, a coil spring clutch element wound closely around adjacent cylindrical portions on both said shaft and said sleeve so that the sleeve and shaft are locked for simultaneous rotation in one direction, an annular collar surrounding said spring and being coupled to one end thereof, an annular operator disposed about said shaft adjacent said collar, said operator and said collar having radially extending portions defining cooperating cam surfaces so that axial movement of the operator rotates said collar in a direction to unwind said spring.

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