

March 12, 1946.

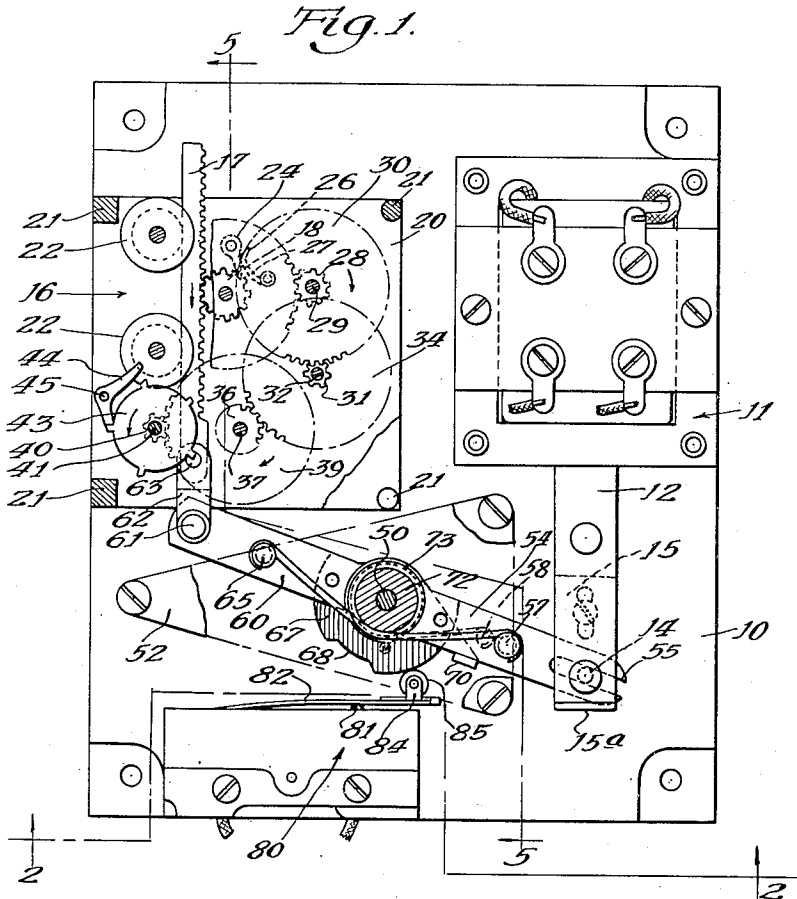
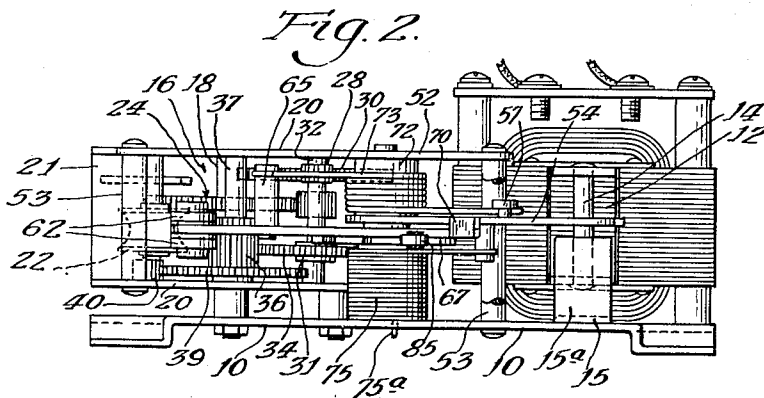
M. G. NELSEN

2,396,523

INSTANT RECYCLING TIME DELAY RELAY

Filed Jan. 7, 1944

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 3.

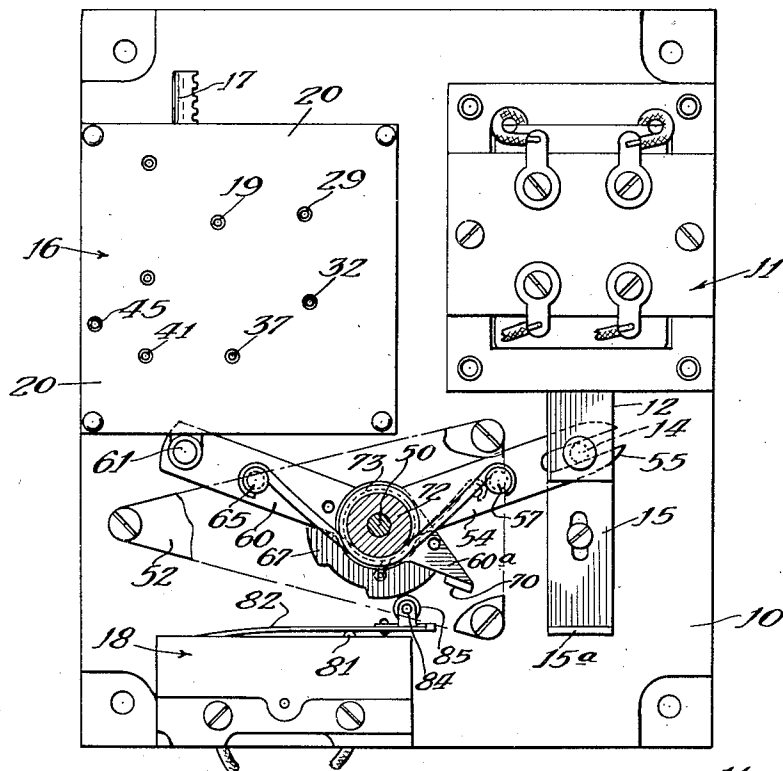
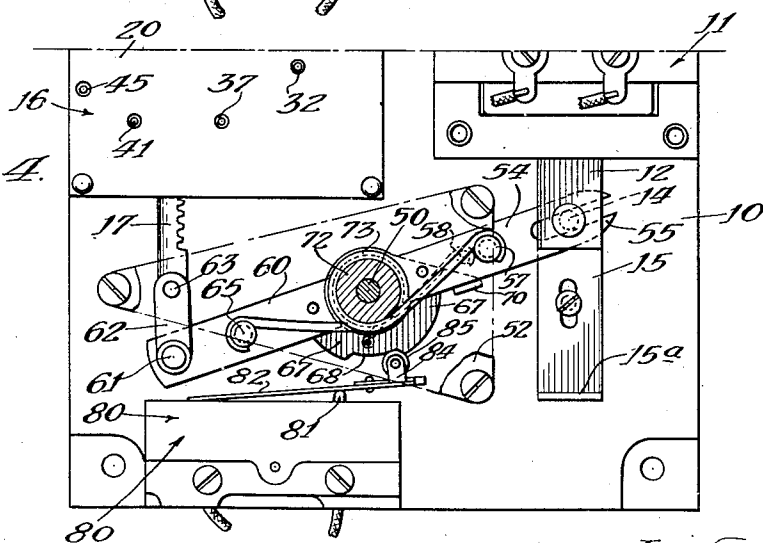


Fig. 4.



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Fig. 5.

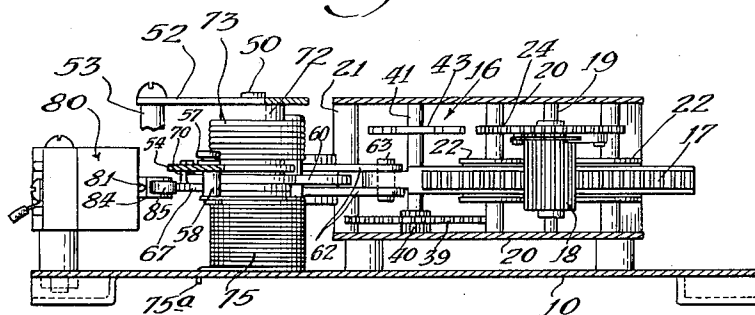


Fig. 6.

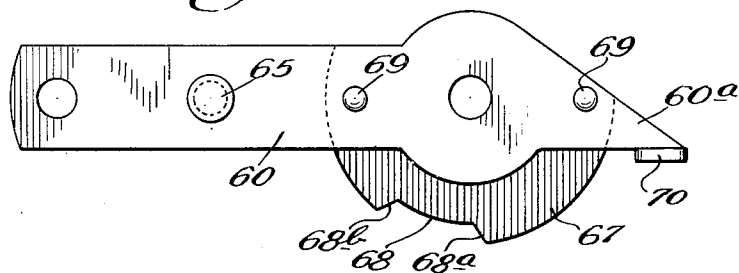


Fig. 7.

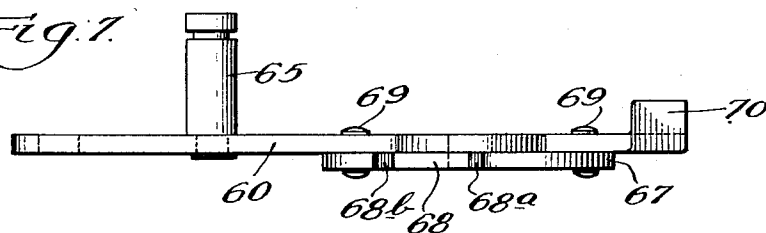


Fig. 8.

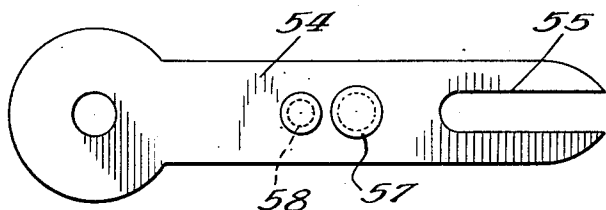
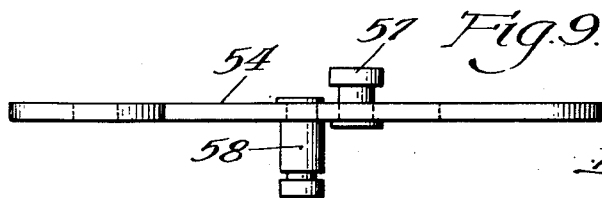


Fig. 9.



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UNITED STATES PATENT OFFICE

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INSTANT RECYCLING TIME-DELAY RELAY

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6 Claims. (Cl. 161—1)

This invention relates to time delay devices of the type wherein certain apparatus or devices to be controlled are actuated a predetermined period of time after actuation of other apparatus or devices. Time delay devices of this general class are adapted to a relatively wide field of use, and may be constructed and arranged to function as a time delay relay or may be utilized to cause mechanical actuation of various apparatus or devices in a time delayed manner with respect to other apparatus or devices initially actuated.

One of the objects of this invention is to provide an improved time delay device utilizing a mechanical clockwork mechanism for performing the timing action, together with a solenoid and interconnecting means by virtue of which the clockwork mechanism is caused to function incident to the movement of the plunger of the solenoid in one direction, and wherein the clockwork mechanism is recocked incident to movement of the plunger of the solenoid in the opposite direction.

Another object is to provide an improved time delay device in which a mechanical clockwork mechanism is actuated by energy built up in a resilient connection between a plunger of a solenoid and the clockwork mechanism incident to movement of the plunger in one direction and wherein a second resilient means effects recocking of the clockwork mechanism, incident to movement of the plunger of the solenoid in the opposite direction.

A further object is to provide an improved time delay device of the character indicated which is constructed and arranged to effect instant recycling of the time delay action.

Still another object is to provide an improved time delay device which is simple in construction, efficient and durable in operation, and which may be economically manufactured.

Other objects and advantages of this invention will be apparent from the following description, taken in connection with the accompanying drawings in which:

Figure 1 is a plan view of the time delay device embodying the present invention, with portions of the mounting plates broken away to show details of construction.

Figure 2 is an end elevational view of the device, taken substantially as indicated at line 2—2 on Figure 1.

Figure 3 is a view similar to Figure 1, showing the position of the parts immediately after the plunger of the solenoid has been attracted.

Figure 4 is a fragmentary plan view showing the

position of the parts at the completion of the timing period.

Figure 5 is a staggered sectional view through the device, taken substantially as indicated at line 5—5 on Figure 1.

Figure 6 is an enlarged plan view of the timer operating lever and associated cam.

Figure 7 is a side elevational view of the timer lever and cam.

Figures 8 and 9 are enlarged plan and side views respectively of the plunger operated lever.

While the embodiment of my invention, as represented in the drawings, is in the form of a time delay relay, manifestly the device may be readily adapted for various purposes to obtain instant recycling, with a time delay actuation of various apparatus or devices which it is desired to control.

The device as represented in the drawings is in the nature of a unitary instrumentality and includes a sheet metal mounting base 10, upon which is rigidly mounted a solenoid 11, having a plunger 12, the outer end of which, as may be seen in Figure 2 of the drawings, is of yoke formation with a transverse pin 14, connecting the outer ends of the legs of said yoke portion. The plunger of the solenoid is limited in its outward movement by a stop member 15, connected to said base, and having an upstanding leg 15a positioned so as to be engaged by the extreme outer end of the lower leg of the yoke portion of the plunger 12.

Disposed adjacent the solenoid is a mechanical clockwork mechanism, indicated generally at 16, of a commercially available type, including a reciprocable rack 17, meshed with a one-way driving pinion 18, mounted on a shaft 19, between a pair of frame plates 20, connected in spaced relation by spacers 21. The edge of the rack, opposite the toothed portion, is seated and guided in a pair of spaced apart, grooved rollers 22. Co-axially mounted with the one-way driving pinion 18, is a gear 24, loosely mounted on the shaft 19, and provided with a driving pawl 26, resiliently urged by a spring 27, carried on said gear, into meshing engagement with the teeth of the pinion 18. As may be seen in Figure 1 of the drawings, the pawl 26 positively connects the pinion 18 and the gear 24, for driving the gear simultaneously therewith, when the pinion is rotated in counterclockwise direction, as a result of downward movement of the rack 17. When the rack 17 is moved in an upwardly direction the pinion 18, by reason of the form and position of the pawl 26, rotates freely and independently of the gear 24.

The gear 24 is meshed with a pinion 28, mounted on a stub shaft 29, which is mounted at opposite

ends in the plates 20. Rigidly attached to the pinion 28 is a gear 30, which in turn meshes with a pinion 31, carried on a stub shaft 32, the ends of which are mounted in the plates 20. Rigidly associated with the pinion 31, is a gear 34, which in turn meshes with a pinion 36, carried on a stub shaft 37, which is mounted at opposite ends in the plates 20. Rigidly associated with the pinion 36, is a gear 39, which in turn is meshed with a pinion 40, mounted on a stub shaft 41, which is mounted at opposite ends in the plates 20.

Rigidly attached to the pinion 40 is an escapement wheel 43, with which cooperates an escapement dog 44, mounted on a pivot shaft 45, carried by the frame plates 20. Thus when the rack 17 is moved in an upwardly direction, as viewed in Figure 1, only the main pinion 18 is rotated, and the remaining gearing of the mechanism remains idle. When the rack 17 moves in a downwardly direction the pinion 18, drives the various gearing above described, and actuates the escapement mechanism, which in turn serves to control the rate of downward movement of the rack 17.

The lower end of the rack 17, and the outer end of the plunger 12, of the solenoid are interconnected by mechanism including means energized as a result of upward movement of the plunger, incident to energization of the solenoid, for actuating the clockwork mechanism, and serving to recock the clockwork mechanism incident to downward or outward movement of the plunger of the solenoid. The connecting means comprises a mounting stud 50, connected at one end in the mounting plate 10 and its upper end is mounted in a triangular shaped plate 52, supported in spaced relation to the mounting plate 10, by means of spacer members 53. Journaled on the stud 50 is a lever 54, the outer end of which is provided with a yoke opening or slot 55 straddling the pin 14 at the outer end of the plunger of the solenoid.

The purpose of the yoke opening is to accommodate the relative movement of the lever to the pin incident to the upward and downward movement of the plunger. The upper face of the lever 54 is provided with a headed stud 57, and the lower face of said lever is provided with a depending headed stud 58. Journaled on the stub shaft 50, below the lever 54, is a lever 60, the outer end of which is pivotally connected by a pivot pin 61 to a clevis formed of a pair of bar elements 62, embracing opposite faces of the lever, and the opposite ends of said bars are pivotally connected by a pivot pin 63, to the opposite face of the lower end of the rack 17. Extending upwardly from the upper face of the lever 60, is a headed stud 65, and mounted concentrically with respect to the pivot axis of the lever 60, is a segmental cam 67, of generally circular contour, and formed with a reduced peripheral portion 68, connected to the outer peripheral portion of the cam by inclined surfaces 68a and 68b. The cam is rigidly attached to the lever by means of a pair of rivets 69. The end of the lever 60, to the right of the pivot axis, terminates in an extension 60a, the downward or lower edge of which is provided with an upstanding stop lug 70, positioned to be engaged by the corresponding edge of the lever 54. Seated upon the lever 54, is a cylindrical plug 72, journaled on the stud 50, and wound around the plug 72 is a coil spring 73, having its terminal portions, at the lower and upper ends of the coil spring respectively, extending a substantial distance laterally, in opposite directions, and anchored on the stud 57 of the lever 54, and the stud 65 of the lever 60, as clearly seen in the drawings.

Mounted below the cam 67 is another cylindrical plug (not shown) seating upon the upper surface of the mounting plate 10, and wound around said plug is a second coil spring 75, the lower end of which, as indicated at 75a, is anchored in an aperture in the mounting plate 10, and the upper end of said coil spring 75 terminates in a lateral extension, the extreme end of which is anchored on the depending stud 58, on the lever 54.

Mounted adjacent the lower edge of the mounting plate 10, is a conventional, commercial type of self-contained snap-action switch, as indicated at 80, which includes a depressible plunger member 81. It is to be understood that in the switch herein disclosed the plunger 81 is normally yieldingly urged in an outwardly direction, and the switch contacts may be of various arrangements, depending upon the nature of the electrical circuit or circuits to be controlled. It is also to be understood that the switch may be in a normally open, or a normally closed position initially, or may normally complete one circuit, and then when actuated break said circuit and complete another circuit. Rigidly attached to the top of the switch is a resilient, actuating arm 82, which extends in a position to engage the outer end of the plunger 81 of the switch. At the extreme outer end of the resilient member 82, is mounted a bracket 83, providing journal support for a roller 84, which by the yielding pressure of the plunger 81, through the member 82 causes said roller to be yieldingly urged against the periphery of the cam 67.

Operation

Let it be assumed that the solenoid 11 is connected in an electrical circuit to be first completed, and that the snap-action switch 80, is included in one or more electrical circuits to be controlled in time delayed relation to the closing of the electrical circuit including the solenoid. When the solenoid circuit is closed and the solenoid is energized, the plunger 12 is instantly retracted so that the parts of the device assume a position as seen in Figure 3 of the drawings. By such movement of the plunger of the solenoid, and the lever 54, the leg of the coil spring 73 connected to said lever, is moved in an upwardly direction, tensioning or loading said spring, so that its opposite leg, connected to the lever 60, exerts a yielding force, tending to draw the rack member 17 of the clockwork mechanism in a downwardly direction. Such movement of the plunger 12, acting through the lever 54, simultaneously loads or tensions the coil spring 75, for a purpose hereinafter referred to.

The built up energy in the spring 73 thus causes actuation of the clockwork mechanism for a predetermined period of time. As the energy of said spring 73 is expended, during which the clockwork mechanism is actuated, the lever 60, moves downwardly, and simultaneously rotates the cam 67 therewith, in a counter clockwise direction, until the roller 84, rides down the shoulder 68a and finally engages the inner cam surface 68, as seen in Figure 4, at which time the plunger 81 of the snap-action switch 80, has moved outwardly to effect operation of the movable switch member or members therein for making or breaking electrical circuits to be controlled, which action of the switch takes place after the lapse of a predetermined interval of time subsequent to initial closure of the circuit including the solenoid 11. The connections to the solenoid and the clockwork timing mechanism are dimensioned and correlated so that immediately after the

snap-action switch is actuated, the stop lug 70 of the lever 60 engages the lower edge of the lever 54 as seen in Figure 4 of the drawings, to cause the parts to remain in the position seen in Figure 4, until the circuit including the solenoid is opened, at which time, due to deenergization of the solenoid, the built up energy in the coil spring 75, acting on the lever 54, causes the lever to move the plunger 12 downwardly in abutting engagement with the stop lug 15a. Due to the relationship of the levers 60 and 54, and by virtue of the lug 70 on lever 60, as seen in Figure 4 of the drawings, the lever 60 is likewise moved simultaneously with the lever 54, in a clockwise direction, thereby moving the rack member 17, in an upwardly direction for recocking the clockwork timing mechanism. Thus the mechanism is restored to a condition for instant recycling so that each time that the circuit, including the solenoid is completed and broken the time delay device is restored to a condition to immediately repeat the timed delayed action of making and, or breaking the electrical circuits being controlled.

Various other types of clockwork devices may be employed in lieu of the rack actuating type herein disclosed. It will also be apparent that the time delay action of the device may be employed for controlling the actuation mechanically of various members for actuating various types of devices in a time delayed manner.

As a specific example of use of my novel time delay device, the device may be utilized in an amplifying circuit wherein the solenoid is connected in a circuit with the filaments of the tubes of amplifying circuit, and the snap-action switch is connected in circuit with the plates of the tubes so as to control the time of supplying energy to the plates to take place a predetermined period of time after the filaments of the tubes are energized.

It will also be manifest that the time interval, as determined by the clockwork mechanism, may be varied considerably for various applications by varying the timer construction, or by the use of different resilient members (which as herein shown are in the form of springs), or by varying the stroke of the plunger of the solenoid, and in various other manners which should be readily apparent.

Although I have herein shown and described a preferred embodiment of my invention, manifestly as above indicated, it is capable of modification and rearrangement without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise embodiment herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respectively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, and means actuated under control of said timing mechanism during actuation thereof.

2. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respectively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, means actuated under control of said timing mechanism during actuation thereof, and a second spring positioned to urge said plunger to its outer position, when the solenoid is deenergized, and causing the first mentioned spring to impart movement through said levers to effect recocking of the timing mechanism.

3. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respectively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, a member connected to said timing mechanism lever; and means actuated by the movement of said member incident to actuation of said timing mechanism for a predetermined period of time.

4. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respectively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, a member connected to said timing mechanism lever, means actuated by the movement of said member incident to actuation of said timing mechanism for a predetermined period of time, and a second spring positioned to urge said plunger to its outer position, when the solenoid is deenergized, and causing the first mentioned spring to impart movement through said levers to effect recocking of the timing mechanism.

5. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respectively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge

said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, means 5 actuated under control of said timing mechanism during actuation thereof, a second spring positioned to urge said plunger to its outer position, when the solenoid is deenergized, and causing the first mentioned spring to impart movement 10 through said levers to effect recocking of the timing mechanism, and stop means for limiting the movement imparted to said levers by said second spring.

6. In a time delay device, the combination of a solenoid having a plunger, clockwork timing mechanism, a pair of coaxially pivoted oppositely extending levers connected at their ends respec-

tively to the end of the plunger and to the timing mechanism, a stop on one lever positioned to engage the other lever for limiting movement of one lever relatively to the other in one direction, a coil spring having its opposite ends connected to said levers, remote from their pivots, tending to urge said levers apart in the said one direction, said spring being tensioned by the inward movement of the plunger, incident to energizing the solenoid, for causing actuation of the timing mechanism for a predetermined period of time, a cam member connected to said lever associated with the timing mechanism, and a snap action switch including a control element engaging said cam member, whereby said member causes actuation of the switch incident to actuation of said timing mechanism.

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