July 19, 1938. F. W. TRUESDELL ET AL 2,124,442

TIME SWITCH

Filed Oct. 17, 1936

Fig. 5.

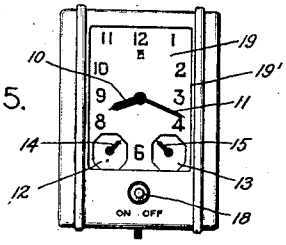



Fig. 1.




Fig. 2.

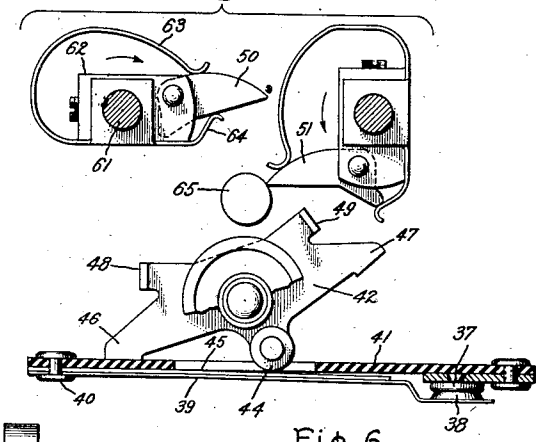



Fig. 4.

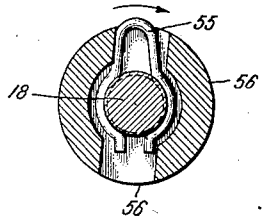



Fig. 3.

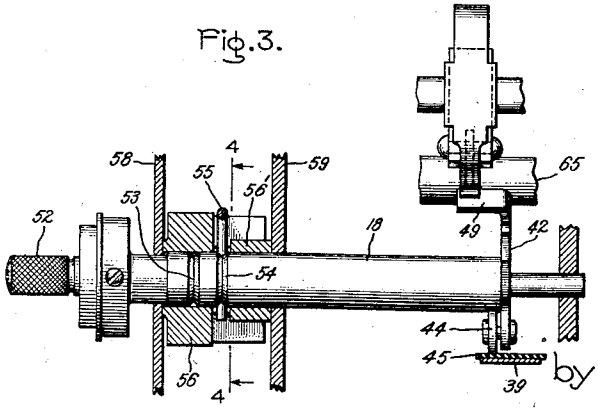
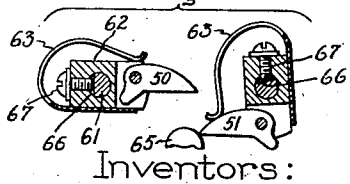



Fig. 6.




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# UNITED STATES PATENT OFFICE

2,124,442

## TIME SWITCH

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Application October 17, 1936, Serial No. 106,180

5 Claims. (Cl. 200—38)

Our invention relates to improvements in time switches and in particular to features which are provided to improve the accuracy, reliability, and flexibility of operation and at the same time keep the construction relatively simple and inexpensive.

The features of our invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of the invention, reference is made in the following description to the accompanying drawing in which Fig. 1 represents an exploded perspective view of a clock train and the time-switch mechanism of a preferred modification of our invention; Fig. 2 is a more detailed view of the switch-operating structure showing one of the switch-opening triggers about to be released to open the switch; Fig. 3 is a side view of the parts shown in Fig. 2; Fig. 4 is a view of an inertia member taken on line 4—4 of Fig. 3; Fig. 5 is a front view of the switch and its casing, and Fig. 6 shows an improved shock cushioning trigger support.

It will be understood that our switch mechanism, the general structure of which is shown in Fig. 1, will usually be enclosed in a suitable casing as indicated in Fig. 5; that the hour and minute hands 10 and 11 will register on a clock dial 19; that such clock dial and the switch-setting indicators 12 and 13 with their pointers 14 and 15 will be exposed to view through a window 19' in such casing; that the disks 16 and 17, which are rotated for setting the times of operation of the switch, and the disk 20 for setting the clock hands will be readily accessible; and that the rod 18, which may be rotated to operate the switch manually and moved endwise to prevent or permit automatic switch operation as desired, will preferably extend through the wall of the casing so as to be accessible from the outside for manual manipulation as desired.

The clock and switch mechanism is driven by a suitable timing motor, which has been represented as a small self-starting synchronous electric motor 21. 22 represents a casing containing speed-reducing gears between the motor rotor and terminal pinion 23. The minute-hand shaft 24 is driven from pinion 23 through gears 25, 26, and 27 and a friction clutch, one member of which comprises gear 27 and the other member of which is a bushing 28 fastened to shaft 24. The hollow hour-hand shaft 29 is driven from the minute-hand shaft through speed-reducing gears 30, 31, 32, and 33. The disk 20 is geared to gear 31 and, by manually turning the disk 20, the hour and minute hands may be set as desired, this being permitted by reason of friction clutch 27—28. It will be understood that the gearing is arranged to drive the minute and hour hands at the usual time-keeping rates in a clockwise direction.

On the hour-hand shaft 29 and driven thereby is a gear 34 through which the switch-operating mechanism is driven. Gear 34 meshes with gears 35 and 36. Gear 35 drives the automatic switch-closing control elements and gear 36 drives the automatic switch-opening control elements. These switch-closing and switch-opening elements are generally similar except that they rotate in opposite directions and a detailed description of one will suffice, but first we will describe the switch, itself.

The switch comprises a stationary contact 37 and a movable contact 38, the latter being carried on a resilient conductor finger 39 fastened at 40 and biased to close contact 38 on contact 37. The switch structure is supported on the under side of a board 41 of insulating material. 42 is a lever for opening and closing the switch. This lever is secured to the rod 18 and the rod is movable to a limited extent in an endwise direction and in a rotational direction about its axis and is suitably supported in supporting plates of the switch structure as shown in Fig. 3. Lever 42 has an arm which extends downward through an opening in insulating plate 41 and which carries a roller 44 at its end bearing on the upper middle surface of resilient switch finger or arm 39. Preferably, there is a thin flexible strip of insulating material 45 between the roller 44 and the switch arm 39 to insulate rod 18 from this switch arm. This insulating strip 45 may be considered as an insulated upper surface of the switch arm 39. In the rotary position of rod 18 and lever 42 shown, the switch contacts at 37 and 38 are closed. When the rod is rotated clockwise, roller 44 presses down on switch blade 39 and opens the switch contacts. Lever 42 carries stop arms 46 and 47 (see Fig. 2), which are adapted to alternately contact the upper surface of insulating board 41 and limit the rotational movement of lever 42 to an angle of about 30 degrees more or less. Thus, in Fig. 2, stop arm 46 is in limiting position with the switch contacts closed. The lever may now be rotated clockwise until arm 47 contacts board 41 at which time roller 44 will have depressed switch blade 39 to open the switch contacts. This represents the limits of rotational movement of the lever. When the switch is open, roller 44 has been moved slightly beyond a perpendicular position with respect to the switch blade 39, so that, when the lever

moves between its two limiting positions, there is a slight toggle action, switch blade 39 acting as the spring of the toggle, which assists in holding the lever 42 in one or the other of its limiting positions with the switch open or closed. It is seen that, by turning the thumb piece 52 at the forward end of rod 18, the switch may be operated manually to open and closed positions.

As was indicated above, rod 18 with lever 42 is movable endwise. The purpose of this movement is to condition the switch for automatic or nonautomatic operation. As best shown in Fig. 3, the rod 18 is there positioned to the front or to the left, to the automatic switch-operating position. When in such position, the forward extending ears 48 and 49, integral with the upper portion of the lever 42, are in the planes of rotation of triggers 50 and 51, which are driven from the clockwork and, as will presently be explained, these triggers serve to rotate the lever 42 between switch-opening and switch-closing positions at predetermined adjustable times for automatic operation. The switch may also be operated manually by turning rod 18 by hand when the rod is in the forward or automatic operating position.

By pushing in on thumb piece 52 or to the right, as viewed in Fig. 3, the rod 18 and lever 42 may be moved inward the distance corresponding to the spacing of the grooves 53 and 54 in such rod. When so moved to the rear, ears 48 and 49 of the lever are moved back of the planes of rotation of triggers 50 and 51 so that these triggers will pass by the ears without contact with any part of lever 42 and the switch will not be operated automatically. The upper insulated surface 45 of switch blade 39 is wide enough so that roller 44 rests thereon in either endwise position of rod 18 and, consequently, the switch may be operated manually by turning thumb piece 52 when the rod is in either of its endwise positions.

In order to definitely hold the rod 18 in either of its endwise positions when moved thereto, we have provided a spring clip 55 about the rod at the position alternately occupied by grooves 53 and 54 in the two endwise positions. This clip is tensioned to grasp the rod and thus snap into the groove which is moved into line therewith and prevents accidental endwise movement of the rod. However, the contacting surfaces of the grooves and the clip are beveled so that, by the application of endwise pressure, the clip may be sprung apart and the rod moved endwise. The clip 55 is prevented from moving endwise because it is held between two bushings 56 and 56' which loosely surround the rod 18 between supporting plates 58 and 59. The rod, when moved endwise, slides freely through the aligned openings in these plates and bushings. The larger bushing 56 has its rear portion slotted and the spring clip 55 is loosely contained in this slot, as best shown in Fig. 4. This arrangement allows bushing 56 to serve as an inertia damper with respect to sudden rotational movements of the rod, which occur with automatic switch operation. This prevents rebound of the lever 42 when automatically moved to switch-closing or switch-opening position. This feature will be clearer after the automatic switch-operating mechanism has been explained and we will refer to it again in the subsequent description.

The switch-closing trigger 50 is driven from the clock train in a clockwise direction by gear 35 through the following elements: Gear 57 meshing with gear 35 and integral with hollow bushing 57', a friction clutch comprising gear 57 and a gear wheel 59 between which there is interposed a resilient friction washer 60, and a shaft 61 on which gear 59 and the support for trigger 50 are secured.

The support for trigger 50 comprises a block 62 secured on shaft 61. This block is slotted at one end and the trigger 50 is pivoted in this slot. Substantially surrounding the block is a strip of spring material having an intermediate portion fastened to the block and its end portions 63 and 64 forming long and short springs which respectively engage with the back and front sides of the trigger as best shown in Fig. 2. These springs serve to resiliently hold the trigger in the position shown by trigger 50 in Fig. 2 when the trigger is free to assume such position. In this position, the tip of the trigger extends substantially radially from shaft 61 in line with its pivot point in block 62. In this position, the point of the trigger is a maximum distance from shaft 61 and thus extends outward a distance so that, as its assembly is rotated, the front surface of the trigger will engage with a stationary post 65 located directly above the pivot of lever 42. Now, as shaft 61 is rotated in a clockwise direction and trigger 50 comes against post 65, the trigger is rotated counterclockwise about its pivot, storing energy in spring 63. This cocking action moves the outer point of the trigger closer to shaft 61 until it can clear post 65, which it does with a snap action and then rotates clockwise about its pivot under the tension of spring 63 until its outer point is again a maximum distance from shaft 61. At the conclusion of this snap action, trigger 50 and its assembly will be approximately in the position shown in Fig. 1.

In Fig. 2, trigger 50 is in the uncocked position and trigger 51 is in a cocked position and the latter is about to snap past post 65, it being understood that the two trigger mechanisms and their cocking and uncocking actions are similar except that they are located on opposite sides of post 65 and rotate in opposite directions. When trigger 50 clears and snaps past post 65, it will strike finger 48 of the switch-operating lever 42 and cause closure of switch contacts 37 and 38 if finger 48 is in position to be struck. Finger 48 will be in such position if the switch is open and rod 18 is pulled forward for automatic switch operation. If, however, the switch is already closed or if its lever 42 is moved to the rear for nonautomatic switch operation, no function is performed by trigger 50 as it uncocks.

Trigger 51, when it uncocks, will strike finger 49 of lever 42 if the switch is closed and set for automatic operation and, if finger 49 is struck, the lever 42 is quickly rotated to open the switch. As pictured in Fig. 2, trigger 51 is about to snap past post 65, strike finger 49, and rotate the lever 42 to open the switch. The energy which is stored in the long trigger springs due to a cocking action is sufficient to positively rotate lever 42 and operate the switch. The automatic switch operation is, therefore, quick and positive but no sudden load is thrown on the clock motor at any time. In the example described, the trigger shafts rotate once in a 24-hour period and energy is stored in the trigger springs over approximately one-fourth revolution of the trigger shafts so that, even if both springs are tensioned simultaneously, the energy is gradually taken from the clock motor over a six-hour period and, under these circumstances, the energy which is required

to operate the switch mechanism does not interfere with accurate clock operation.

The short spring **64** serves primarily to cushion the shock incident to the snapping action of the triggers particularly when no automatic switch operation is performed and the full force of the energy stored in the long spring is encountered by the short spring. It is desirable that this shock be cushioned to minimize noise and wear but it is particularly important that it be cushioned to prevent the shock from causing any slipping of the friction clutches corresponding to parts **57**, **59**, and **60** as this would change the times set for automatic switch operations.

It will be noted that shaft **61** has pointer **14** secured thereto and that the shaft **57'** fastened to gear **57** carries the 24-hour dial **12**. The trigger assembly is so oriented on shaft **61** that pointer **14** indicates the time on dial **12** when an automatic switch-closing operation will occur. The shaft **61** with pointer **14** and the trigger assembly may be set as desired by rotating disk **16** which is connected to shaft **61** through gears **66** and **59**. When pointer **14** is thus being set to time the occurrence of an automatic switch-closing operation, the friction clutch at **59** slips. The operating and setting arrangement for timing an automatic switch-opening operation differs only in that an extra gear **67** is provided in the drive to the switch-operating elements to reverse the direction of rotation and setting dial **13** has its 24-hour graduations reversed to correspond.

It is seen that the shock incident to the action of triggers **50** and **51** might cause slipping of the setting clutches if not cushioned. Such slipping would cause changes in the times set for automatic switch operations. The shape of the surfaces of the triggers on which the long and short springs bear, the relative stiffness of the springs, and the points of spring contact with respect to the pivot point of the triggers are designed and arranged to contribute to the results desired. It will be noted that the torque arm with which the long spring **63** acts on the trigger, that is, the distance from the pivot point of the trigger to the point of spring contact, decreases considerably during the uncocking action. Thus, in Fig. 2, the long spring contacts trigger **51** near the outer point of the trigger in the cocked position while the long spring **63** rests against trigger **50** much nearer the pivot when the trigger is uncocked. The acting force furnished by the long spring decreases very rapidly from the cocked to the uncocked condition both by reason of the decrease in spring tension and by reason of the shortening of its torque arm. The short spring **64** is relatively stiff as compared to the long spring. The surface of the trigger on which the short spring bears is so shaped that, during the initial portion of an uncocking action, the short spring produces no retarding action and may even assist the long spring in accelerating the trigger (see trigger **51**, Fig. 2). However, during the final portion of the trigger movement about its pivot, the distance between the trigger pivot and the point of contact of the short spring rapidly increases until, in the final position (see trigger **50**, Fig. 2), its torque arm is greater than that of the long spring. The cushioning action of the short spring does not occur, however, until the trigger has passed the point where it may strike a turning blow to the switch lever **42**. The joint action of these springs is, therefore, effective in first rapidly accelerating the trigger so that an effective blow may be struck on the switch-operating lever and finally cushioning the shock that would otherwise occur in stopping rotation of the trigger, particularly in the case where the switch lever is out of contacting position with respect to the trigger and hence all of the kinetic energy of the trigger remains to be absorbed.

In Fig. 6, we have shown alternative means on the trigger supports for cushioning the torsional shocks incident to the uncocking action of the triggers. The arrangement of Fig. 6 is somewhat more effective than the arrangement of Fig. 2, is simpler, and is, therefore, to be preferred. The triggers, the trigger supports, and the main springs bearing against the rear edges of the triggers in Fig. 6 are substantially the same as in Fig. 2. The trigger supports are, however, mounted on their shafts in a way that permits limited relative rotational motion. Opposite the trigger supports, their shafts have slots cut therein as shown at **66**, Fig. 6. A screw **67** is threaded through the end of each trigger support opposite the trigger thereon and enters the slot **66** cut in the shaft. These screws are of such length that their heads screw down tightly against the outer surface of the trigger support when their inner ends have a slight clearance with the bottoms of the slots **66**. Since the triggers are free to rotate on their shafts within the limits permitted by the inner ends of the screws contacting the flat surface of the slots, limited rotational movement of the trigger supports on their shafts is permitted.

The screws **67** and slots **66** may also serve to hold the trigger supports in place lengthwise of their shafts. The short springs **64** bearing against the front edge of the triggers, as shown in Fig. 2, are no longer necessary and are omitted in Fig. 6. The shock incident to an uncocking action is cushioned or dissipated by more or less turning movement of the entire trigger support on its shaft.

The trigger support shown at the left in Fig. 6 is at the center of its range of rotation on its shaft. The trigger support shown at the right has been rotated into the cocked position of its trigger **51** and the support has rotated on its shaft to the limit of such movement in one direction. When the trigger **51** is released from post **65**, it rotates on its pivot under tension of the long spring **63** and snaps around to the uncocked position in its support. (Trigger **50** is shown in such uncocked position.) Any remaining shock tending to turn the trigger support counterclockwise is completely absorbed by the trigger support as a whole rotating on its shaft through a small angle. No semblance of a torsional blow is imparted to the trigger support driving shaft.

It is seen that we have provided a relatively simple mechanism for striking the switch-operating lever **42** with a sharp effective blow at predetermined adjustable times without detriment to the time-keeping properties of the clock and without disturbing the time-setting of the switch under any condition. A sharp blow is desirable to assure quick and positive operation of the switch not only when the switch is new and clean but also after considerable service when it may be expected that wear, the collection of dust, etc., will have reduced the efficiency of the mechanism appreciably.

One disturbing factor incident to giving the switch-operating lever a sharp blow is the tendency to rebound, and cause chattering of the contacts, or of leaving them only partially closed or opened. We have guarded against this by providing the inertia bushing member **56** loose on

shaft 18 but connected in driving relation therewith through a lost motion coupling consisting of the spring clip 55 loosely fitting in the slot cut in the bushing as shown in Fig. 4. The functioning of this device to prevent a rebound may be explained as follows:

Let it be assumed that the shaft 18, Fig. 4, has been quickly rotated in a clockwise direction in response to an automatic switch operation and is suddenly stopped in the position shown. Prior to the sudden stopping action, inertia bushing 56 will have been driven in a clockwise direction by reason of spring clip 55 pushing against the top right inner surface of such slot. When the shaft stops, spring clip 55 also stops. The inertia bushing, however, because of its inertia, tends to keep on rotating clockwise, hence it strikes spring clip 55 on the left inner top surface of the slot where these parts are shown in contact immediately after shaft 18 has been suddenly stopped. Consequently, if there is any tendency for a rebound and movement of shaft 18 in a counterclockwise direction, this tendency is offset and checked as soon as it occurs by the momentum of the inertia bushing. If the momentum of this bushing is slightly greater than is necessary to counteract the rebound impulses, no harm is done since the excess momentum will be absorbed by a frictional turning of the spring clip on shaft 18. It will be evident that this inertia device works equally well for either direction of rotation of shaft 18.

The various setting devices will be marked with suitable legends to designate their purposes and manner of operation. The main operating features of the switch will now be briefly reviewed. The timing motor 21 drives the clock hands 10 and 11 in the usual manner. These hands may be set by turning disk 20, during which setting operation there is slipping of clutch 27—28. Also such setting rotates the switch operating trains and consequently they are always properly oriented with respect to the black hands. The "on" trigger 50 is driven through gears 34, 35, 57, and 59 in a clockwise direction at one revolution in twenty-four hours. The time at which it will perform its switch-closing operation may be set by rotating the trigger with respect to the clock hands. This is done by turning shaft 61 through setting disk 16 at which time slipping occurs between gears 57 and 59. The time position for which trigger 50 is set is indicated by pointer 14 on the 24-hour dial 12. The parts for setting and driving trigger 51, which automatically opens the switch, are similar to those just mentioned except that an extra gear 67 is provided for reversing the direction of rotation of trigger 51 and the graduations on 24-hour dial 13 are reversed to correspond. The "time on" and "time off" settings may be made as close together or as far apart as desired. The planes of rotation of triggers 50 and 51 are offset just enough so that, if they should both be set for operation at substantially the same time, they will not interfere when they are in the time position of trigger 50, Fig. 2. The springs on the trigger assemblies provide for storing energy from the clock motor over a considerable period of time and releasing it suddenly to positively and quickly operate the switch. The spring arrangement also effectively cushions any shock resulting from release of this stored energy in order that it shall not cause creeping in the friction clutches and consequent change in the times for which the switch is set to open or close. The switch may be operated manually at any time by turning rod 18 through thumb nut 52, including times directly before and directly after an automatic operation, because the only time a trigger is in the path of movement of fingers 43 or 49 of the switch-operating lever is at the instant of an automatic operation.

Automatic operation may be suspended and resumed at will by pushing in and pulling out rod 18 a slight distance. This in no way interferes with manual operation of the switch. Rebound of the switch mechanism is prevented during automatic operation by the inertia member 56 and spring clip 55. These parts are also a part of the mechanism for holding the shaft 18 in either of its endwise positions. The electric circuit which is controlled by the switch and the switch, itself, are insulated from the remainder of the device by reason of the insulated upper surface of switch blade 39. The switch operation is made easy by using a roller at 44 instead of a nonrolling shoe. The lever 42 is held in either of its extreme rotary positions by the slight toggle action of this roller in conjunction with the resiliency of the switch blade 39.

While we have provided a switch having the various desirable features previously described, we have also provided a switch which is comparatively simple in construction and reasonable in cost.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention together with the apparatus which we now consider to represent the best embodiment thereof but we desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. In a time switch mechanism, a switch, a pivoted lever for operating said switch, said lever being rotatable about its pivot in opposite directions between alternate switch-closing and switch-opening positions, a trigger for striking said lever a blow to quickly move it from switch-closing to switch-opening position, a trigger for striking said lever a blow to quickly move it from switch-opening to switch-closing position, supports in which said triggers are pivotally mounted, a timing motor for driving said supports in opposite directions of rotation, friction clutches between said motor and trigger supports by means of which the supports may be independently rotatively adjusted with respect to the timing motor for the purpose of adjusting the times of automatic switch operation, a stationary member near said lever against which said triggers are rotated by said timing motor to perform cocking and uncocking actions on said triggers, springs associated with said triggers and their supports, a cocking action serving to cause rotation of a trigger on its support in one direction and the storing of energy in its spring until the trigger is in a position to move past said member, thereby resulting in an uncocking action and a rapid return rotation of such trigger on its support under the action of its spring, said switch lever having projections which, in the alternate positions of said lever, may extend into the paths of rotation of the different triggers during their uncocking actions so as to be struck a switch-operating blow, and means on said trigger supports for cushioning the torsional shocks thereon incident to the uncocking actions of said triggers.

2. In a time switch, a constant-speed shaft, a trigger support thereon, a trigger pivoted in said

support on an axis parallel to said shaft and extending substantially radially from said shaft beyond the pivot point, springs secured on said support and bearing against the front and rear edges of said trigger beyond the pivot point to resiliently hold the trigger in such substantially radially extending condition, a stationary post against which the front outer portion of said trigger is moved by rotation of said shaft, said action serving to rotate the trigger in its support and store up energy in the spring bearing against its rear edge until said trigger has moved past said post and is released, whereby the trigger snaps back to its substantially radially extending position under the tension of said spring, and switch-operating means which may be positioned to be struck and operated by said trigger when it snaps back towards the substantially radially extended position, the spring bearing against the front of said trigger serving to cushion the rotational shock incident to said trigger snapping action only after said trigger has snapped beyond such striking position.

3. In an automatic time switch device, a switch, a rotary lever for operating said switch, said switch being operated from closed to open position and vice versa by rotation of said lever in opposite directions respectively between fixed limits, a timer motor, means for storing energy from said timer motor and releasing it to strike said lever a blow and quickly rotate it to perform a switching operation at a predetermined time, and a rotary inertia member connected in driving relation with said lever through a lost-motion connection and serving to prevent a rebound of said lever after being quickly rotated in an automatic switching operation.

4. In an automatic time switch mechanism, a switch, a lever for operating said switch, a shaft on which said lever is secured, said switch being operated from closed to open position by rotation of said shaft and lever in one direction between fixed limits and being operated from open to closed positions by rotation of said shaft and lever in the opposite direction between said limits, automatic means for striking said lever sharp blows for quickly rotating it in opposite directions between said limits at predetermined times, said shaft and lever being movable endwise from a position where it will be engaged by said automatic means for automatic switch operation to a position clear of the path of movement of said automatic means, said lever, however, remaining effective to operate said switch by rotary movement in either endwise position, provisions for retaining said shaft in either endwise position comprising grooves cut in the surface of said shaft and spaced apart the distance of such endwise movement, a spring clip resiliently grasping said shaft at the position alternately occupied by said grooves for the different endwise positions of said shaft, and means for preventing endwise movement of said spring clip with said shaft including bushing means restrained from endwise movement through which said shaft extends, said bushing means having a slot in which said spring clip extends to form a loose rotary driving connection between said shaft and bushing means, said bushing means having sufficient inertia to counteract the tendency for said lever to rebound after being suddenly rotated in an automatic switch-operating movement.

5. In a time switch, a constant-speed shaft, a trigger support thereon, a trigger pivoted in said support on an axis parallel to said shaft and extending substantially radially from said shaft beyond the pivot point when the trigger is in an uncocked condition, a spring secured on said support adapted to bear against the rear edge of said trigger beyond the pivot point when said trigger is in a cocked condition, a stationary post against which the front edge of said trigger is moved by rotation of said shaft, said action serving to rotate the trigger in its support and store up energy in said spring until said trigger has moved past said support and is released, whereby the trigger is snapped back to its substantially radially extending position under the tension of said spring, switch-operating means which may be positioned to be struck and operated by said trigger when so snapped, and a lost-motion rotary driving connection between said shaft and trigger support, whereby said support is permitted to rotate on said shaft a limited amount and absorb any rotational shock energy incident to said trigger-snapping action.

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