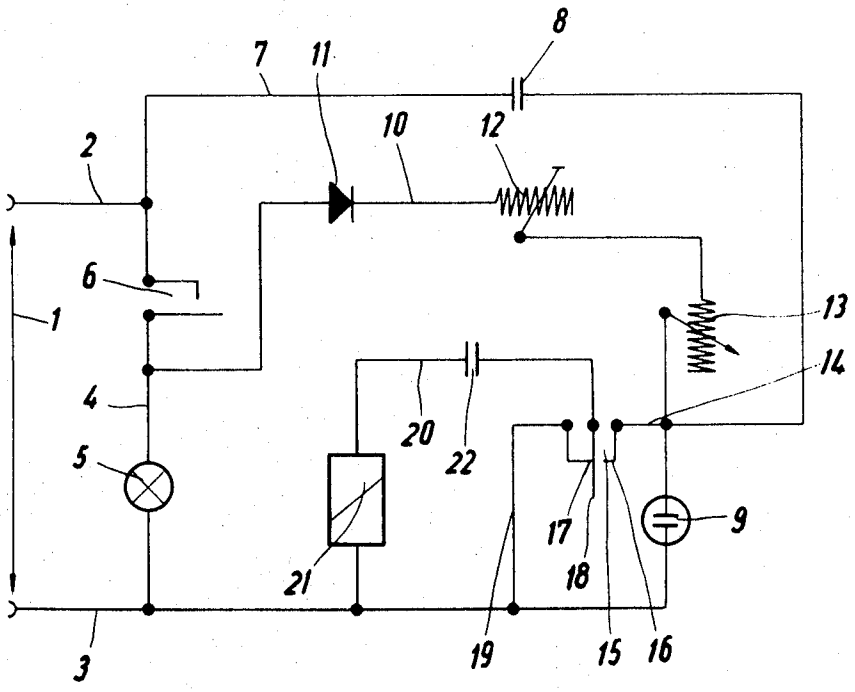
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ELECTRIC TIME SWITCH

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Fig. 1



ELECTRIC TIME SWITCH

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Fig. 2

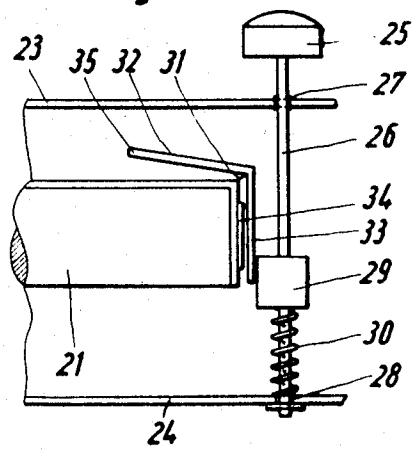
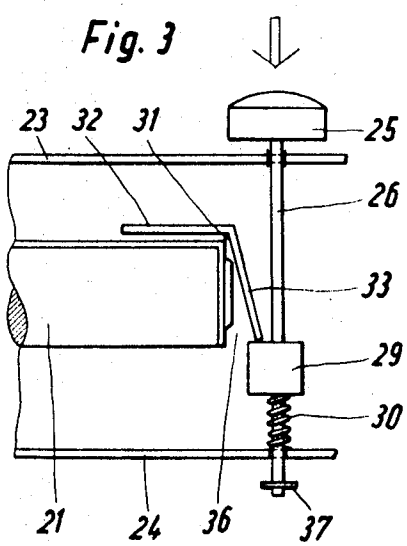


Fig. 3



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ELECTRIC TIME SWITCH

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Fig. 4

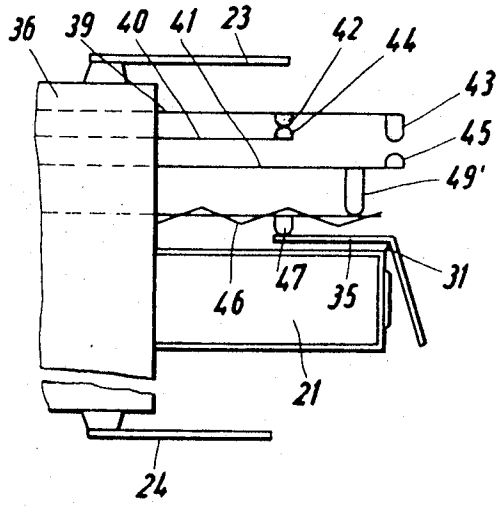
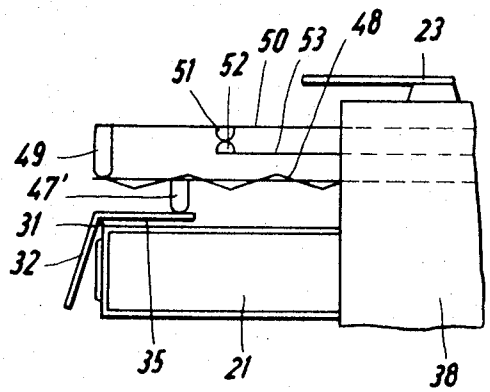


Fig. 5



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3,469,108

ELECTRIC TIME SWITCH

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Claims priority, application Germany, July 21,1965, L 51,186
Int. Cl. H01h 7/14
U.S. Cl. 307—141 7 Claims

ABSTRACT OF THE DISCLOSURE

A timing switch incorporating a spring-biased trigger in sliding engagement with the armature of a relay having a set of load contacts and a set of switching contacts. A momentary depression of the trigger releases the armature resulting in the closure of the load contacts for a predetermined time interval as determined by the constants of an electrical timing circuit controlling the energization of the relay operating coil through the switching contacts. Upon energization of the operating coil, the trigger automatically returns into blocking engagement with the armature, thereby limiting actuation of the time switch to a single operating cycle of controlled time interval. When the trigger is retained in the depressed position the armature is free to operate in the normal manner and the timing circuit effects repetitive energization of the relay operating coil, thereby resulting in a repeated series of controlled time intervals.

This invention relates to an electric time switch for controlling an event which can be initiated by electrical excitation, such time switch comprising a manual trigger for initiating the operation and a relay connected in an electrical circuit and operating in mechanical conjunction with the manual trigger.

It has already been proposed to construct such a time switch so that switching off takes place after the expiration of a time interval independent of whether the manual trigger has yet been operated or not. This is particularly important if very short times are to be controlled.

A usual time switch, particularly for exposure or illumination devices on copying machines, in which the above-mentioned event is the exposure time, is adjustable within a fixed interval of some 2 to 6 seconds. Certain qualities of paper, or even colored sheets which need to be copied now and then, frequently require a longer exposure. This is possible with so-called surface exposure machines in which the sensitive material and the pattern can remain for any length of time on the exposure device. The known timers, however, do not permit the processing of such difficult materials which require relatively long exposure times, and possibly occasionally even a trans-illumination exposure, and under such circumstances one has to trigger the time switch several times and let the light penetrate through each time. This process is comparatively involved and expensive, since not only is additional manual operation necessary, but in addition and more particularly the machine is badly utilized in the making of large numbers of copies, since there always remains a certain pause between the individual exposure intervals.

A further consideration arises in respect of those simpler machines in which a pressure plate is not pre-tensioned for operation but is pressed down by hand, namely, that the operator having to perform an additional actuation of the time switch can lead to a displacement of the machine or of the plate which is pressed down manually, with the result that the copies are rendered useless.

It is an object of the present invention to provide a time switch which, in spite of using a system having a limited adjustable time interval, enables exposure times to be achieved which are a multiple of the pre-set adjusted or longest possible time interval of the time control arrangement, the switch being triggered by a manual trigger, but without the need for multiple actuation thereof.

This is achieved in accordance with the present invention in that a time control arrangement is provided which, upon release, provides a repeated series of controlled time intervals, and which includes a manual trigger which in its operated position permits a repetition of the time intervals by disengagement of a stop and which after its release is movable back at the end of the time interval during which it is released into its initial position in which the stop prevents operation of the time control arrangement in order to cut-off and disconnect the time control device.

In particular, the invention provides that the manual trigger is provided with said stop which co-operates with a contact-actuating relay armature and which mechanically holds the relay armature when the manual trigger is released in a position corresponding to energization of the relay, but which upon actuation of the manual trigger allows the relay armature to move into a position corresponding to de-energization of the relay. The invention also provides a time control element which is rendered operative by the operation of the manual trigger, as is also a control contact for the event, the time control element being arranged to open the control contact for a short time upon energization of the relay. The invention also provides that with the manual trigger in its operated state and with the stop disengaged a further control process is free to take place through de-energization of the relay.

Preferably, the invention makes use of a time control arrangement which includes a capacitor, the adjustable charge on the capacitor determining the time constant and the relay being connected in the capacitor discharge circuit. Thus, a repeated tripping or initiating of the relay into its operative state is ensured so long as the stop is disengaged from its contact with the relay armature as a result of actuation of the manual trigger.

In a preferred embodiment, two relay contact switches are provided which are engageable through the agency of the manual trigger, one of which switches controls the electrical excitation for the event which is being controlled and additionally closes a charging circuit for the capacitor, which the other of said switches is a change-over switch which switches a preionizable circuit element from a by-pass circuit into the discharge circuit of the capacitor so that constant switching times are achieved from the first controlled event onwards.

The change-over switch is preferably a single-pole double-throw switch and is so constructed that the contact which is closed by the relay armature being held triggered first opens only after the other changeover switch contact has closed.

In another preferred embodiment of the invention, the manual trigger is formed as a push-button, and the stop is formed as a stepped, enlarged portion of the stem of the push-button and operates under the action of a spring which attempts to urge the manual trigger into its said initial position. This enlarged portion of the push-button stem is associated with the relay armature in such manner that it is movable upon release of the manual trigger to a position in front of the armature which is located in the relay-energized or attracted position, and is constructed in such manner that it includes a step on which the armature, when located in its de-energized position, supports itself in an easily slidable manner.

In order that the invention may be fully understood, an embodiment thereof will now be described in detail by

way of example and with reference to the accompanying drawings, in which:

FIG. 1 is an electrical circuit diagram of a time switch in accordance with the present invention;

FIGS. 2 and 3 are schematic side views of the manual trigger which co-operates with the relay in the circuit as shown in FIG. 1; and

FIGS. 4 and 5 are two different side views of the relay contacts respectively illustrating the two separate switches which are controlled by the relay armature and which are represented in FIG. 1.

According to FIG. 1, an energy source **1** is provided, for example from a socket switch or a voltage terminal, and in the present case is a source of 220 volts A.C. A circuit mesh **4** is connected across the voltage source by means of two supply leads **2** and **3** and in the present embodiment an exciter lamp **5** is connected in the circuit mesh **4**. This exciter lamp **5** is the element to be controlled by the time switch. The lamp **5** is switched into the circuit mesh **4** by means of an onoff /contact switch **6**, to be described in more detail later with reference to FIG. 5. For the control of other events or processes, for example for controlling a servo-motor, a suitable control device for the servo-motor may be provided instead of the lamp **5**.

The supply leads **2** and **3** also feed a further circuit mesh **7** which is connected across the supply leads **2** and **3** and which has a capacitor **8**, for example of approximately 250 pf., and also a relay valve **9** connected therein. The relay valve **9** may have, for example, a firing voltage of approximately 200 volts and a cut-off potential of 50 volts. So long as this valve has not yet been actuated, it will first give a current output of the desired value when the potential of 200 volts is reached. However, it cuts off again when the voltage falls after firing to less than 50 volts.

The capacitor **8** ensures that a pre-ionization of the relay valve **9** always takes place. This is important in order that the chosen firing voltage value and cut-off potential value are always maintained exactly constant from the very first time that the arrangement is operated onwards.

A further circuit mesh **10** extends from a point in circuit mesh **4** between the contact switch **6** and the lamp **5** to a point in circuit mesh **7** between the capacitor **8** and the relay valve **9**. In this mesh **10** there is connected in series a current gating device **11**, i.e. particularly a rectifier, and thereafter a resistance network of resistances **12** and **13**, at least one of said resistances, i.e. resistance **13**, being adjustable in order to select a fixed time period. The resistances **12** and **13** are preferably of the order of 100 to 350 KΩ.

From the junction point of the circuit meshes **7** and **10** extends a by-pass conductor **14** which includes a change-over switch **15**, also described later with reference to FIG. 4. This change-over switch **15** is a single-pole double-throw switch having two switching contacts **16** and **17** and a relatively movable switching arm **18** which co-operates with the switching contacts **16** and **17** alternately but with a certain time overlap. Switching contact **16** is connected to conductor **14**, and switching contact **17** is connected by way of a conductor **19** either to circuit mesh **7** at a point between the relay valve **9** and supply lead **3** as shown or to supply lead **2**. The movable switching arm **18** is connected to a circuit mesh **20** which includes a relay **21** as well as a capacitor **22**, for example of 4 mf., connected between the relay **21** and the switching arm **18**. The circuit mesh **20** has its other end connected to supply lead **3**.

The on/off switch **6** and the change-over switch **15** have their contacts mounted on the relay **21** and will be described more fully with reference to FIGS. 4 and 5, particularly in order to show more clearly how it is that switching contact **17** first opens only after switching contact **16** is closed upon a reversal of the change-over switch **15**.

These contacts are, with reference to the relay, arranged as normally closed contacts, i.e. they are open when the relay **21** is energized or when the armature of the relay which operates the contacts is located in the position corresponding to energization, or else they are positioned as shown i.e. the change-over switch arm **18** engaging switching contact **17**, when switching contact **16** is open.

It will be realized that in the arrangement as shown in FIG. 1 the lamp **5** is without current and a pre-ionization current through the relay tube only flows through circuit mesh **7**. By means which will now be described the illustrated position is maintained when the relay is de-energized so that the relay armature, even with the not yet energized relay in the initial position of the arrangement, is secured by mechanical means in the position which corresponds to the de-energized state of the relay.

Upon actuation of this mechanical means, for example by means of a manual switch, the relay armature can move after its release into a position which corresponds to the not energized relay, since the relay **21** finds itself in the initial position in the not energized state and capacitor **22** can fully discharge itself via circuit mesh **20**, conductor **19** and a part of circuit mesh **7**. This movement can be assisted by special springs, or it may take place only as a result of the inherent spring qualities of the contact elements. In this case, the on/off contact switch **6** closes, the lamp lights up, and a current flows from supply lead **2** through circuit mesh **10** since the impedance between capacitor **8** and resistances **12** and **13** is suitably chosen so that the current is conducted through circuit mesh **10**.

Simultaneously, the change-over switch **15** reverses so that switching contact **16** is engaged by the movable contact arm **18**. Thus, circuit mesh **20** with its capacitor **22** and relay **21** is connected in parallel with the pre-ionized relay valve **9**. The capacitor **22** is thus charged up according to the magnitude of the variable resistance **13** until it reaches the firing potential of the relay valve **9**. Then, the capacitor **22** discharges and the relay **21** is operated promptly. By means of the resultant armature movement the on/off contact switch **6** and the change-over switch **15** return to the illustrated positions, whereupon the above-mentioned time-wise overlap of the switching between switching contacts **16** and **17** again occurs. This overlap avoids in a simple way any contact bounce and ensures thereby that the whole discharge of the capacitor contributes to operating the relay, even when the cut-off potential of the relay valve **9** is reached. If in this case the relay armature is freely movable, then, when the current in circuit mesh **20** falls below the cut-out value for the relay **21**, the relay armature again moves so that the on/off contact switch **6** closes and the change-over switch **15** effects movement of its movable arm **18** into contact with switching contact **16**. The process then repeats itself.

By choice of the switching elements one can ensure that the intermediate time between different periods of energization of the lamp **5** is extremely short, so that in practice the extinction of the lamp is not in general visible with the human eye.

The mechanical means for effecting the control according to the invention is shown in FIGS. 2 and 3. In a switch housing, not shown in more detail elsewhere, and which comprises an upper wall **23** and a base or lower wall **24**, a manual trigger in the form of a push-button is mounted. The button **25** itself is disposed above the upper wall **23**, and its stem **26** extends down through apertures **27** and **28** in the respective walls **23** and **24** so that the push-button is held perpendicular to the walls. A cylindrical enlargement **29** is provided on the stem **26** of the push-button. Between the enlargement **29** and the lower wall **24** is disposed a pressure spring **30** around the stem of the push-button which attempts to urge the push-button upwardly, and against its upward force the cylindrical enlargement **29** can be moved downwardly by exerting pressure on the button **25**.

In the switch housing between the walls 23 and 24 is located the relay 21. The relay is constructed in the usual manner. The relay armature 32 is pivotably mounted at 31. The relay armature 32 has a first arm 33 which is movable in front of the core 34 of the relay 21, and a second arm 35 which operates the switching contacts of switches 6 and 15 in a manner to be described later with reference to FIGS. 4 and 5.

The relay armature 32 is movable between the two positions shown respectively in FIGS. 2 and 3. FIG. 2 shows one position in which the first arm 33 contacts the relay core 34 and which corresponds to the energized state of the relay 21. This position is maintained, by means of mechanical clamping by the enlargement 29, even in the not energized state of the relay when the push-button is displaced upwardly by the spring 30 so that the enlargement 29 can slide in front of said first arm 33 of the armature.

This position can only be achieved by the enlargement when the relay is energized at least for a short time so that there is a clear upward path of movement for the enlargement 29 past first arm 33 of the armature.

When the push-button as shown in FIG. 2 is operated, the enlargement 29 is displaced downwardly so far that the relay armature 32, with the relay in the not energized state, pivots or moves in an anti-clockwise direction. Thus, the lower end of said first arm 33 takes up a position on a step 36 (FIG. 3) formed by the enlargement 29, so that the push-button is itself then locked in its lower position even when it is released from finger pressure. If the relay is energized in the position as shown in FIG. 3, then the initial torque on the armature 32 is arranged to be so great that arm 33 can be withdrawn from the step 36, which for example may be bevelled on the left-hand side as viewed in FIG. 3 to facilitate this movement. When arm 3 is withdrawn the spring 30 forces the enlargement 29 upwards until a stop 37 at the lower end of the stem 26 prevents any further upward movement due to its engagement with the underside of the lower wall 24. Thus, the position shown in FIG. 2 is again reached.

FIGS. 4 and 5 show respectively different side views of the contact groups forming the switches 15 and 6 of FIG. 1. These contact groups are arranged side-by-side above said second, actuating arm 35 of the relay armature 32. The base 38 of the respective switches is, for example, connected to the upper and lower walls 23 and 24. FIG. 4 shows the change-over switch 15 mounted above the body of the relay 21 and the armature 32. Three contact-carrying lamellae 39, 40 and 41 of an electrically conductive and preferably resilient material project from the switch base 38. The uppermost lamella 39 carries two contacts 42 and 43 located at different distances from the switch base 38. A contact 44 on the central lamella 40 is arranged to co-operate with the contact 42 disposed nearer to the switch base 38 on the upper lamella 39, and the other contact 43 on the upper lamella is arranged to co-operate with a contact 45 on the lowest lamella 41. Operation of the switch is effected by means of a spring clip 46 extending outwardly of the switch base 38. The actuating arm 35 of the relay armature 32 presses against a pressure stud 47 on the underside of the spring clip and a further pressure stud 49' depending from the lowest lamella 41 is arranged to contact the upper side of the spring clip. The spring clip 46 is arranged to urge the relay armature 32 into its upwardly or downwardly displaced position. It will be realised that, by an energization of the relay, the spring clip rises and the lowest lamella 41 is raised by means of the depending pressure stud 49' until contacts 43 and 45 close. This corresponds to a closing of switching contact 17 and the movable arm 18 of the switch 15 of FIG. 1. Initially thereafter, with upward movement of the uppermost lamella 39, contact 42 breaks from contact 44, which, with reference to FIG. 1, corresponds to the engagement of switching contact 16 and the movable arm 18. In the reverse process, contacts 42 and 44 close first before contacts 43 and 45 open.

FIG. 5 shows the contact group for the on/off switch 6 of FIG. 1. By means of the actuating arm 35 of the relay armature 32 a pressure stud 47' depending from a spring clip 48 is moved upwards together with the spring clip until the end of the spring clip contacts a stop member 49 depending from a lamella 50. This lamella 50 is mounted in the switch base 38 and carries a contact 51 which is arranged to make with a contact 52 carried by a second lamella 53 disposed between said first lamella 50 and the spring clip 48. It will be seen that the contacts 51 and 52 are urged away from one another when the relay armature 32 comes into a position corresponding to the energized state of the relay. The lamellae 50 and 53 and the contacts 51 and 52 form the on/off switch 6 of FIG. 1. The breaking of the lamellae corresponds to the position shown in FIG. 1.

FIGS. 1 and 2 show the initial position. If the push-button is then moved into position shown in FIG. 3, the relay armature 32 moves into its anti-clockwise pivoted position. The switches 6 and 16 close so that the time control period begins. If the push-button is released within this time period, then energization of the relay 21 causes the enlargement 29 to return to the position shown in FIG. 2 after the first time period and the arrangement is again locked in the initial position.

If the push-button is depressed for longer than corresponds to a pre-set time period, then the relay 21 becomes operative and the switches 6 and 15 return to their positions as indicated in FIG. 1. Since, however, the energization of the relay follows as a result of a current pulse from capacitor 22, the energized state is very short and the relay armature 32 again returns to the position as shown in FIG. 3, i.e. it closes itself automatically for a new time control sequence. The exposure time may be set, for example, for periods of 5 seconds duration. Thus, by depressing the push-button for only 11 seconds a total time period of 15 seconds results.

Since the switching process is audible from the change-over of the relay, or under certain circumstances can be made audible by acoustic means, for example by means of a clapper which co-operates with the armature 32 and which strikes against a plate, the operator can easily estimate how long the push-button must be depressed for a desired period of illumination. It is essential that only one trigger should have to be manually operated in order to achieve under any given circumstances any desired length of controlled illumination, while an immediate release of the trigger 25 after individual depressions of the button ensures that the device returns to its initial position after the expiration of the pre-set and initiated time period and is then locked in this initial position. It is surprising that this new principle can be applied to exposure control with such extraordinarily simple means.

The invention has been described with reference to electrical circuitry which operates with a chargeable capacitor as the time control element. It will be apparent to one skilled in the art that in order to carry out this principle of permitting the expiration of a number of time periods by actuating a manual trigger in proportion to the actuating time, various other means could be used, such as electric motors or mechanically driven elements which co-operate with locking devices and/or electrical cut-outs, wherein the locking devices and cut-outs are coupled to the manual trigger so that they remain disengaged for longer times or close by engagement during one time period of the total controlled time with the termination of this time period.

The mechanical arrangement shown in FIGS. 2 and 3 in combination with the arrangements shown in FIGS. 4 and 5 illustrate essential features of the invention in respect of the mechanical locking of a relay armature in dependence on pre-set switch positions. The spatial ar-

rangement of the parts is also of importance in order to fulfill the locking function satisfactorily.

I claim:

1. A device for controlling an element by electrical means which are connectable in circuit through a switch, said device comprising,

(a) a relay mounted on a support and having an armature movable between first and second positions corresponding respectively to the de-energized and energized state of the relay,

(b) switch means cooperating with the armature, which switch means includes an on-off switch which is closed when the armature is in its first position and open when the armature is in its second position, said switch means also including a change-over switch,

(c) a spring-biased, manually-operable trigger carrying a stop and mounted on said support adjacent to said relay, said trigger being movable from a normal first position wherein the stop retains the armature in its second position to a second position wherein the stop is moved out of the path of travel of the armature,

(d) terminal means for supplying energy for said electrical means and relay, and

(e) time delay means alternately connected across said terminals and across said relay by said change-over switch as the armature occupies its second and first positions respectively, said time delay means momentarily energizing the relay a predetermined time interval after the said armature moves into its first position; the arrangement being such that upon momentary movement of the trigger to its second position the armature moves to its first position and into the path of travel of said stop thereby retaining the trigger substantially in its second position, said trigger returning to its first position when the relay is energized.

2. The invention as recited in claim 1, wherein the said time delay means is a capacitor and wherein the said change-over switch comprises a pair of switching contacts which are open when the armature is in its second position and a pair of shorting contacts which are closed when the armature is in its second position; and including a preionizable switching element connected across the said terminals; circuit elements connecting one side of said switching element to said capacitor through the said switching contacts; and circuit elements connecting the capacitor across the relay through the said shorting contacts.

3. A device as claimed in claim 1, in which a capacitor connected in series with the relay is the time delay means, a first circuit mesh is provided to connect the electrical means, the relay and said capacitor, said circuit mesh being connectable through sets of switching contacts on said change-over switch by means of which said first circuit mesh which is connected on the one hand to said terminal means can be selectively short-circuited through a first set of contacts of the change-over switch and can be selectively connected through a second set of contacts of the change-over switch to a second circuit mesh which is connected to said terminal means of opposite polarity, and wherein the element to be controlled is connected between said terminal means in series connection with said on-off switch.

4. A device as claimed in claim 3, in which a preionizable switching element is connected in said second circuit mesh which extends between said terminal means, and wherein the first and second sets of contacts of the change-over switch are connected to the said second circuit mesh on opposite sides of the pre-ionizable switching element.

5. A device as claimed in claim 4, in which the preionizable switching element is a relay valve which permits current flow therethrough at a fixed voltage value, and wherein said second circuit mesh includes a second capacitor.

6. A device as claimed in claim 4, in which a second capacitor is connected in said second circuit mesh and a third circuit mesh is provided which is connected on the one hand between the element to be controlled and the said on-off switch and on the other hand to the second circuit mesh at a point between the second capacitor and the pre-ionizable switching element, said third circuit mesh having connected therein at least one adjustable resistance in series connection with a rectifier, said resistance being of a value with reference to the said second capacitor that current flows through said third circuit mesh which is in parallel with the section of the second circuit mesh including the said capacitor upon closure of the on-off switch.

7. A device as claimed in claim 4, in which the first and second sets of contacts of the change-over switch are so arranged that each set of contacts in the closed position is first opened only after the other set of contacts is closed.

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