July 13, 1937. M. H. RHODES 2,087,071

ELECTRIC SWITCH

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FIG. 1.

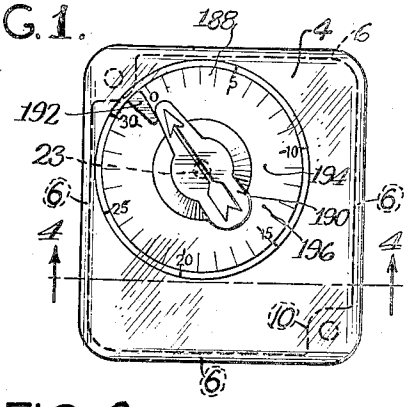


FIG. 2.

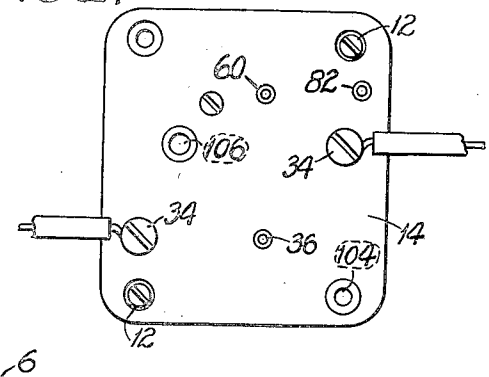


FIG. 3.

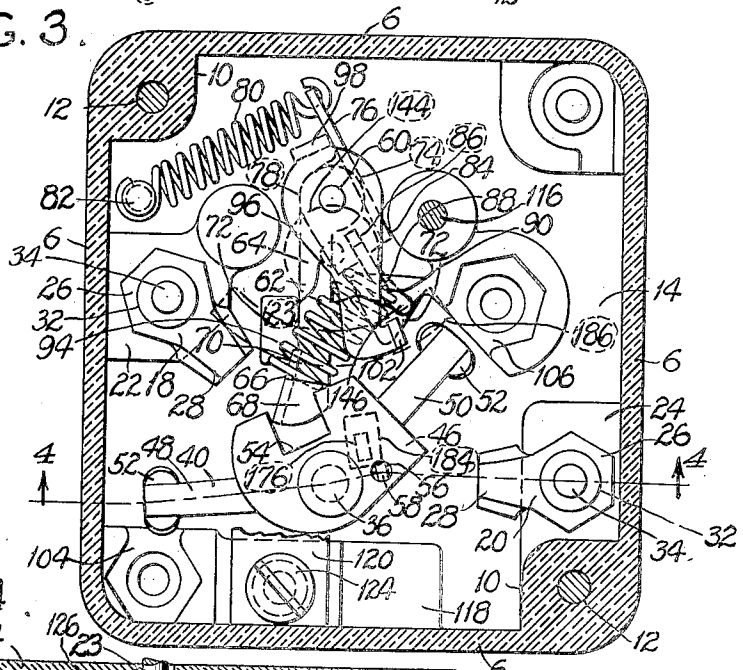
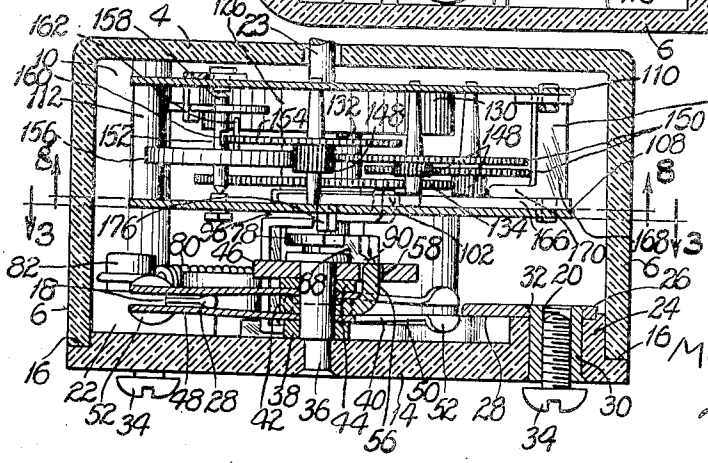


FIG. 4.



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ELECTRIC SWITCH

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FIG. 5.

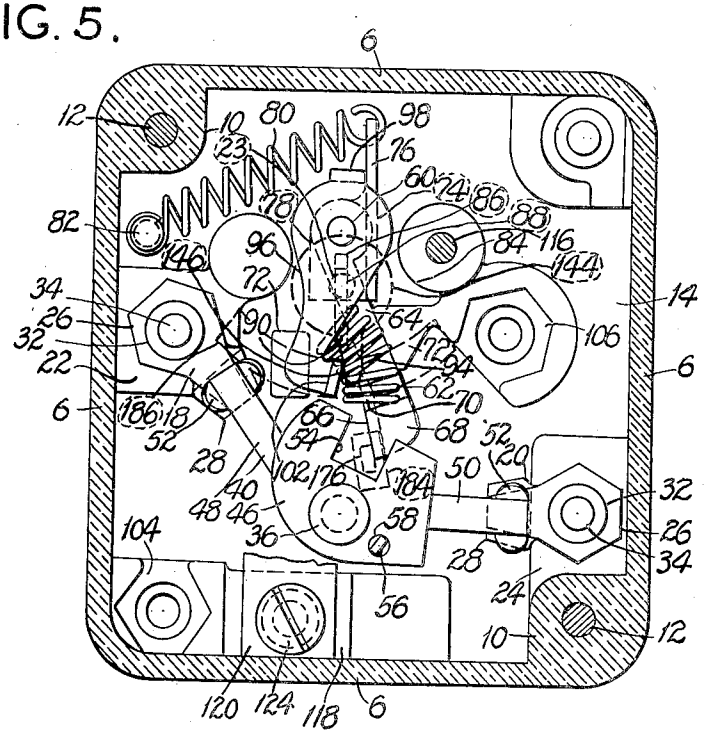
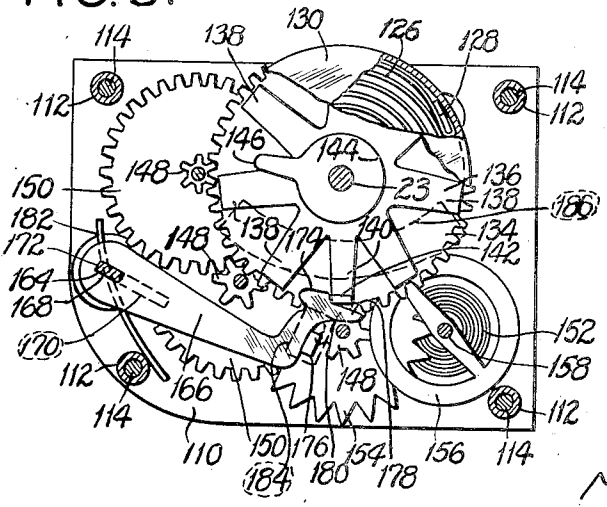


FIG. 8.



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ELECTRIC SWITCH

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FIG. 6

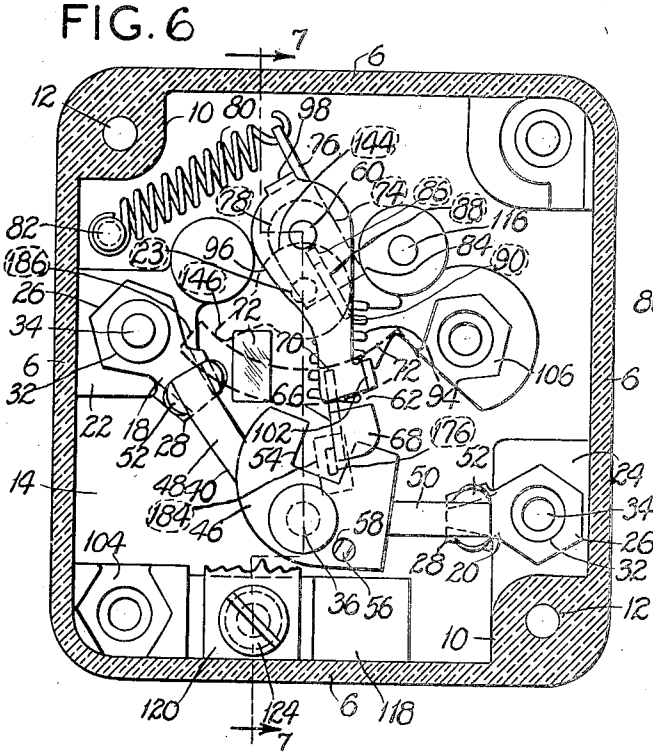


FIG. 7.

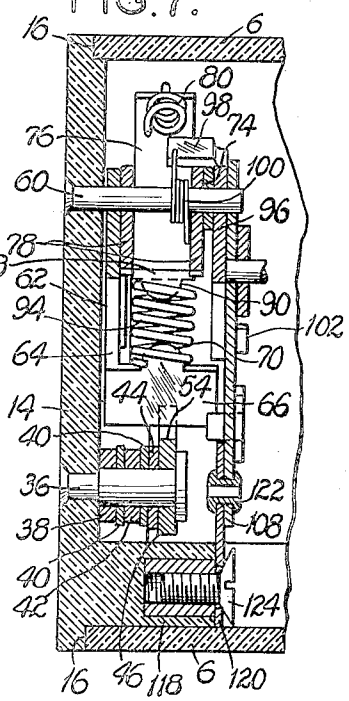
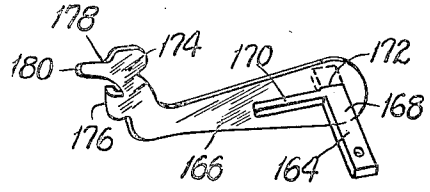


FIG. 9.



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UNITED STATES PATENT OFFICE

2,087,071

ELECTRIC SWITCH

Marcus H. Rhodes, Hartford, Conn., assignor to M. H. Rhodes, Inc., Hartford, Conn., a corporation of Delaware

Application May 29, 1933, Serial No. 673,421

5 Claims. (Cl. 200—38)

This invention relates to electric switches, and with regard to certain more specific features, to electric time-controlled switches.

Among the several objects of the invention may be noted the provision of an electric time-controlled switch which has but one handle for both actuating and setting purposes, said handle being arranged to be used consecutively as a switch-actuating handle and then as a time-setting handle; the provision of a switch of the class described which makes and breaks contacts with a snapping action, thereby avoiding deleterious arcing and sparking; and the provision of a switch of the class described which is relatively simple in construction and operation, and which is so constructed as to have a minimum number of wearing parts. Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which are illustrated several of various possible embodiments of the invention,

Fig. 1 is a front elevation of a time-controlled switch embodying the present invention;

Fig. 2 is a back elevation of the switch shown in Fig. 1;

Fig. 3 is a plan of a base forming a part of the switch of Fig. 1;

Fig. 4 is a cross section taken on line 4—4 of Figs. 1 and 3;

Fig. 5 is a view similar to Fig. 3, but illustrating certain parts in alternative operating positions;

Fig. 6 is a view similar to Figs. 3 and 5, but illustrating still further operating positions;

Fig. 7 is a cross section taken substantially on line 7—7 of Fig. 6;

Fig. 8 is a cross section taken substantially on line 8—8 of Fig. 4; and,

Fig. 9 is a perspective view of a latch lever.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Fig. 1, numeral 2 indicates a switch casing, which preferably comprises a molded bakelite or like material box having a front 4 and four sides 6 formed integrally. Through a suitable hole in the front 4 projects a shaft 23 which comprises the main shaft of the switch. Two opposite corners of the box 2 have molded therein fillets 10, which are drilled and tapped to receive screws 12, which screws 12 serve to hold a back mounting panel or base 14 to the box. The base 14 (see Figures 4 and 7) is grooved as at numeral 16 to receive the edges of the sides 6.

On the front 4 of the box there is provided a dial 188, and a handle or cooperating indicating knob 190 is provided on the end of main shaft 23. A projection 192 molded with the switch housing serves as a stop to prevent rotation of the knob 190 in the wrong direction. Suitable index characters on the dial 188 indicate the particular delay for which the switch is set at any given instant. A pair of dots 194 and 196 are also provided on the dial 188, the dot 194 indicating the device to have reached the stage indicated by Fig. 5, while the dot 196 indicates that the device has reached the stage indicated by Fig. 6, as is more fully pointed out hereinafter. Instructions to the user of the switch should specify that, to operate it, the knob should first be rotated in a clockwise manner past the two dots 194 and 196 (at each of which a "click" will be heard), and then set to the desired time delay, either greater or less than that represented by the location of the dots. The switch may be turned "off" at any time while it is running by merely manually rotating the knob back to zero setting, and thus replacing the time-controlled running down with an instantaneous manual running down.

The base 14 is likewise formed of molded material, such as bakelite, and includes a number of projections and the like integrally formed therewith, which projections will be individually indicated as the occasion arises in this description.

Broadly speaking, the time-controlled switch comprises two parts, namely, the mechanical switching mechanism and the time delay mechanism, which are interconnected by a series of latches and the like. For clarity, the mechanical switching mechanism will first be described, and thereafter the time delay mechanism, while the two will be correlated in connection with the description of the operation of the switch as a whole.

The mechanical switching mechanism is mounted entirely upon the base 14. It comprises a pair of terminals 18 and 20, which are supported on projections 22 and 24, respectively, molded integrally with the base 14. Each terminal comprises a flat piece of brass having a hexagonal portion 26 which fits into a receiving hexagonal depression in the projections 22 and

24, and an outwardly extending, doubly-beveled portion 26. The terminals are mounted on the base 14 in the manner illustrated in Fig. 4. An inwardly threaded hollow cylinder 30 is molded permanently into the base 14, and extends therethrough. The inner end of the cylinder 30 is upset as at numeral 32 to clamp the hexagonal portion 26 of the terminal. Into the outer end of the cylinder 30 is threaded a screw 34, which screw 34 comprises the means for making exterior connections to the switch.

Mounted on a pin 36 which is supported in the base 14 (see Figures 3, 4 and 7) is a rotating contactor bar assembly. This assembly comprises a spacing washer 38, a double-blade contactor bar per se 40, which is spaced apart by a second washer 42, a third, spacing washer 44, and an anvil piece 46. The contactor bar 40 has two arms 48 and 50, which extend radially from the pin 36 in such directions that when one engages the terminal 18, the other will be engaging the terminal 20. The arms of the bar 40 each comprise two spaced blades of spring material, such as copper, brass or bronze, and each blade terminates sidewardly with flared lips 52, so as the better to engage the terminals 18 and 20. The anvil piece 46 preferably comprises fiber or similar material, and includes, on its upper surface, a substantially rectangular notch 54. The spacing washer 42 has an upturned projection 56 which fits into a hole 58 in the anvil piece 46, whereby rotation of the anvil piece 46 relatively to the contactor bar 40 is positively prevented.

It will readily be seen that through rotation of the anvil piece 46, the terminals 18 and 20 may be connected or disconnected at will with the coextensive rotation of the contactor bar 40. The devices thus far described may be characterized as the electrical elements of the mechanical switching mechanism.

The switch operating mechanism is substantially all mounted upon a pin 60 which is supported in base 14 (see Figures 3 and 7). First in order of mounting on the pin 60 is a swingable hammer saddle member 62, which comprises an arm 64, at the upper end of which is a hole through which the pin 60 passes, a cross piece 66, and a portion 68 parallel to the arm 64. On the cross piece 66 is a nose 70, the function of which will be indicated hereinafter. The arm 64 is of suitable length such that the cross piece 66 at all times fits within the notch 54 in the anvil piece 46. Swinging of the hammer saddle 62 is limited by a pair of projections 72 molded on the base 14.

The next piece mounted on the pin 60 is a member 74, which comprises a plate 76 which is parallel to the axis of the pin 60, but displaced therefrom, and a pair of projections 78 extending at right angles from the plate 76 and drilled to slide on the pin 60. The plate 76 extends some distance upwardly from the projections 78, and at its upper end is drilled to receive one end of a tension spring 80, the other end of which is anchored to a pin 82 mounted near the edge of base 14. Since the spring 80 always imparts a counterclockwise rotational tendency to the member 74, and since it is necessary to limit the rotation of said member 74 in that direction, a stop pillar 84 is molded as part of the base 14, against which the lower end of plate 76 abuts to limit such rotation. The pillar 84 also serves as a mounting means, as will be pointed out more fully hereinafter. On a line with the pin 60, a pair of slots 86 are provided in the projections 78, into which slots slides a plate 88 having a nose 90 at the front end thereof.

Reacting between the nose 70 on the hammer saddle 62 and the nose 90 on the plate 88 (and hence the member 74) is a compression spring 94. The compression spring 94, member 74, and hammer saddle 62 together constitute an overcentering device, as follows: When the member 74 is rotated clockwise, against the spring 80, and the hammer saddle 62 is held stationary by reason of its engagement with the left-hand projection 72 (in other words, when the member 74 is rotated clockwise from its position as indicated in Fig. 3), the compression spring 94 is slowly compressed against the nose 70 on the hammer saddle, until a point is reached where the nose 70, the axis of the spring 94, and the nose 90 are all in line and radial to the pin 60. As the member 74 passes this position, the force of the compression spring is liberated by its swinging the hammer saddle sharply to the right, in a counterclockwise manner, until it is stopped by the right-hand projection 72. The reverse action takes place when the member 74 is returned to its original position, as it rotates counterclockwise under the force of spring 80, and the hammer saddle is swung sharply to the left in a clockwise manner. As the hammer saddle swings, its cross piece 66 is forced sharply against opposite sides of the notch 54 in the anvil piece 46, thus snapping the contactor bar into and out of connection with the terminals 18 and 20. In this manner contacts are made and broken with a much-to-be-desired snap action, and thus arcing and sparking, and consequent pitting and erosion of the contacts is avoided.

The last element rotating upon the pin 60 comprises a lever 96, which is provided, at its short end, with a downwardly-turned projection 98 that fits behind the extending portion of plate 76 of member 74. A small coil spring 100 (see Fig. 7) encircles the pin 60, and bears at one end against the plate 88, while the other end bears against the projection 98. The coil spring 100 tends to return the lever 96 always to such a position that the projection 98 abuts the plate 76. It will be seen that clockwise rotation of the lever 96 perforce carries with it the member 74, but the lever 96 is free to rotate independently of the member 74 in a counterclockwise direction. The lower, and longer end of the lever 96 is provided with an upstanding projection 102, which projection functions in a manner to be indicated hereinafter.

By reference to Fig. 3, it will be seen that the contactor bar assembly, when in "off" position, assumes such a location with respect to the base that it might well be connecting two other terminals. For this reason, projections 104 and 106 are provided on the base 14, these projections resembling the projections 22 and 24 with their hexagonal depressions, but being normally undrilled. If it is desired to reverse the order of operation of the switch as a whole (that is, if it be desired that the switch turn "on" the current after a predetermined "off" time, instead of the more normal sequence in which the switch turns "off" the current after a predetermined "on" time) the terminals 18 and 20 are mounted on the projections 104 and 106 in place of the projections 22 and 24. Or, the switch may originally be equipped with terminals on all four projections 22, 24, 104, and 106, in which event it may be used for either sequence of operations at will or for

controlling two circuits (in opposite phases) at the same time.

This substantially completes the description of the mechanical switching mechanism, and the time delay mechanism will next be described.

The time delay mechanism, broadly, comprises a main spring, an escapement train permitting said main spring to unwind itself only in a slow, controlled manner, and a pair of latches which cooperate with the mechanical switching device to operate the same. The time delay mechanism is mounted between two brass plates 108 and 110 (see Figs. 4 and 8), which are spaced apart by collars 112 on screws 114. The plate 108 is in turn mounted on the pillar 84 projecting from base 14, by means of a screw 116 that extends through to the exterior of the base 14, and upon a projection or block 118 formed integrally with the base 14, in the latter case by means of a strip 120 (see Fig. 7) which is riveted at one end to the plate 108, as at numeral 122, and which is held to the projection 118 at its other end by a screw 124.

The time delay mechanism as a whole operates upon the main shaft 23, which, it will be remembered, extends from the front of the switch housing. Said shaft 23 is borne in the plates 108 and 110, and has mounted thereon, immediately beneath the plate 110, a coiled main spring 126, the inner end of which is securely affixed to said shaft. The outer end of the main spring 126 is secured to a projection 128 struck from the relatively immovable plate 110. A main spring cover 130 encloses the spring and prevents it from accumulating dust, etc. The cover is secured to the shaft 23, and is rotatable therewith.

Immediately behind the cover 130 a collar 132 is mounted on the main shaft 23, the collar 132 serving to space a main gear 134. The gear 134 rotates freely on and relative to the main shaft 23. Immediately behind the main gear 134 is a spring spider member 136, which comprises a central portion which is secured to the shaft 23 against rotation relative thereto, and a number of radially projecting spring fingers 138, which are sprung to bear forcibly upon the surface of main gear 134. The frictional force of the fingers 138 on the gear 134 is such that, when the main shaft 23 is manually rotated, as in setting the switch, the fingers slip freely on the surface of the gear, without carrying it in coextensive rotation, but when the main spring alone is tending to unwind, through the escapement train, the slow force is sufficient that the gear 134 is compelled to rotate simultaneously with the main shaft 23. This arrangement constitutes a form of clutch, in which engagement is had provided the force is applied to the driven member in a very slow, uniform manner, but in which no engagement is had if the force is applied quickly and unevenly (as it is with manual rotation of the main shaft 23). One of the fingers 138, which is separately designated as 140, has a downwardly-turned projection 142 on the end thereof, the purpose of which will be indicated hereinafter.

Behind the spider member 136 on the shaft 23 is mounted a small disc 144, which has a projection 146 in its own plane. The disc 144 is immovable relative to the shaft 23. Its function will be indicated hereinafter.

Engaging the main gear 134 is a pinion 148, which constitutes the first element of a timing or escapement train. The escapement train will not be described in great detail herein, since it is of the same type as those shown in my Patents Numbers 1,895,398 and 1,895,399, dated January 24, 1933. Broadly, it comprises a series of pinions 148 and gears 150, which are arranged one gear and one pinion to a shaft, each shaft being supported in bearings in the plates 108 and 110, and which together effect a large increase (or decrease) in angular rotation from the main shaft 23 to an escapement mechanism 152. The escapement 152 comprises a toothed wheel 154 and a balance wheel 156, the latter being mounted on a balance staff 158 having a notch 160 therein which, together with a pin 162 mounted on the balance wheel 156 allows the escapement wheel 154 to rotate only one tooth at a time, and at definite intervals. For a further description of the escapement mechanism, reference is made to the copending application of Frederick Franz, Serial No. 410,358, filed November 29, 1929, for Escapement, now Patent No. 1,934,611, dated November 7, 1933.

It will now be seen that the operation of the timing means is substantially as follows: Assume that the device is initially "run down" and at rest. The shaft 23 is manually rotated in a direction to wind the main spring 126 (this direction being counterclockwise in Fig. 8). As the main spring is wound, the clutching mechanism 136 slips and the main gear 134 remains stationary. However, whenever the winding is stopped, the clutching means 136 immediately takes hold of the gear 134, and further rotation of the shaft 23 and gear 134 is simultaneous. As soon as the winding is stopped, there is placed upon the shaft 23 a clockwise torque, by reason of the tendency of the main spring 126 to unwind itself. The shaft 23, however, cannot now rotate without rotating the main gear 134, and the main gear 134 can rotate only in a very slow, timed manner as controlled by the escapement mechanism and gear train. Thus, the main shaft 23, after once having been wound, can unwind under its own power only at a predetermined, slow speed. If the shaft 23 is rotated manually in a clockwise (unwinding) direction, however, the clutch 136 again slips and the main spring may be manually returned to "run down" position without awaiting the action of the escapement mechanism.

Supported on a bar 164 which is in turn supported in suitable holes in the plates 108 and 110 is a latch lever 166, the particular construction of which (and of the bar 164) is indicated in Fig. 9. Referring to Fig. 9, it will be seen that the bar 164 comprises a stamping of relatively thin sheet metal or the like which has a cross member 168 and a perpendicular projection 170 extending therefrom. The lever 166 has at one end a rectangular hole 172 which receives the cross member 168, the lever thus being non-rotatable on the bar 164. The lever 166 has at its other end an upstanding portion 174, from the front face of which extends, at right angles to the plane of the lever, a projection or latch 176. On the upper surface of the portion 174 is provided a sloping edge or cam 178, which terminates with a projection 180. The cam edge 178 is normally in position to be engaged by the projection 142 of the clutching means 136.

When in position between the plates 108 and 110, the latch lever 166 is held against the inner face of plate 108 by the projection 170 of the bar 164. A single tempered steel wire 182 passes through a hole in the bar 164, and bears at its other end against one of the spacing collars 112,

and provides a spring force normally urging the latch lever into its uppermost position.

The plate 108 is provided with an arcuate slot 184 (see Fig. 8) through which the projection 176 from latch lever 166 extends into the chamber occupied by the mechanical switching mechanism, in position to intercept or pass the hammer saddle 62 as it swings upon the pin 60. A second arcuate slot 186 (see also Fig. 8) is also provided in plate 108, the slot 186 being arcuate about a center represented by the pin 60 of the mechanical switching mechanism. Through the slot 186 passes the projection 102 of lever 96 of the mechanical switching mechanism, to engage and disengage the projection 146 of disc 144. Since the projection 102 moves about one center, while the projection 146 moves about another center, it will be apparent that the two will rotate together, in engagement, only for a predetermined distance, after which they will clear each other.

The above completes the description of the various elements of the mechanical switching device and the time delay mechanism. The conjoint operation of the two will now be described.

Assume, again, that the device is initially in "run down" position, the main spring being unwound. The mechanical switching elements are in their position as indicated in Fig. 3, connections being "off". The main shaft 23 is now manually rotated, as by manipulation of the knob 190, in a direction adapted to wind the main spring. For the first few degrees of rotation, nothing happens. Then the projection 146 engages the projection 102, and as further rotation takes place, the lever 96 likewise rotates on pin 60. Instantaneously the projection 98 on the upper end of lever 96 engages the face of plate 76 of member 74, and forcibly causes the member 74 to rotate along with it, against the spring 80. Rotation continues with lever 96 and member 74 rotating evenly with the shaft 23. However, soon the member 74 passes the overcentering position, and the hammer saddle 62 is thrown sharply to the left in the manner hereinbefore indicated to cause the circuit to be closed. Meanwhile the projection 142 of the clutching means 136 has passed from engagement with the cam edge 178, and the latch lever 166 has, under the influence of the spring 182, rotated into its upper position, where its projection 176, which passes through the slot 184 in plate 108, is in position to engage the swinging hammer saddle 62. The projection 176 has no effect upon the hammer saddle 62 when the saddle swings from left to right, because of the sloping lower edge of said hammer saddle (which enables it to momentarily push the projection aside), but it is effective to latch the saddle 62 against rotation from right to left.

With the elements in their Fig. 5 position, further rotation of a few degrees brings the projection 146 out of engagement with the projection 102, and the assembly on the pin 60, comprising the member 74 and lever 96, immediately, under the powerful reaction of spring 80, rotates to the left to return to its original position. This return normally would again overcenter the spring 94, and throw the hammer saddle to the left, but the projection 176 is in place and the hammer saddle 62 is thus prevented from swinging and the current is left "on". However, the spring 94 is cocked in position to swing the saddle 62 as soon as the projection 176 is removed from its path. The position of the elements at the completion of this stage of the operation is that indicated by Fig. 6.

The switch is now "on", and the further rotation of the main shaft 23 is for the purpose of setting the time delay. While all of the foregoing has been going on, the main spring has been being wound, but the clutch 136 has been slipping to prevent rotation of the main gear 134. Rotation of the shaft 23 may be continued if it is desired to set the switch for a longer time delay than that already set, or, if a lesser time delay is wanted, the shaft may be rotated in the reverse direction to the required extent. All of this further rotation is without effect upon the mechanical switching elements. The time relay to be set, it will be seen, is proportional to the rotation of the main shaft 23 in the winding direction.

Assuming that the requisite delay has been set, the rotation of the main shaft 23 is stopped, and the escapement means immediately come into operation in the manner specified, allowing the main shaft to return to "run down" position only at a measured, slow speed. Nothing happens until the device nears "run down" position, when the projection 142 again comes into contact with the cam edge 178 of the latch lever 166. The shape of the cam edge 178 is such that, at the moment the device returns completely to "run down" position, the lever 166 is depressed to the extent that the projection 176 disengages the hammer saddle 62, whereupon the compression spring 80 forces the hammer saddle 62 sharply to the left, and the contactor bar is rotated to break connection. Thus, at the expiration of the predetermined, set time interval, the connections are broke and the switch goes "off".

At the same time that the switch goes "off", or slightly prior thereto, the projection 146 again engages the projection 102 of lever 96, this time on the reverse side. Thus, the lever 96 is carried along in counterclockwise rotation, it being free to do this because it engages the member 74 only upon clockwise rotation. However, before the device turns "off", the projections 146 and 102 have again passed beyond the circumferential region of their engagement, and the projection 146 has slipped the projection 102 and returned to the original side thereof, in position for a subsequent operation.

At the end of this sequence of events, the switch is again in the position illustrated in Fig. 3, and is ready for further operation.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in carrying out the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A time-controlled switch comprising a pair of terminals, a contactor bar movable to connect and to disconnect said terminals, overcentering means for operating said contactor bar, a main shaft, means associated with said main shaft for engaging said overcentering means to operate the same during a fraction of the rotation of said main shaft, a main spring associated with said main shaft, and a timing train connected to said main shaft by a clutching means, means for manually rotating said main shaft, and latching means adapted to intercept the movement of said contactor bar, said latching means being opera-

tive according to the position of said main shaft, whereby, upon initial rotation of said main shaft, said overcentering means is actuated to change the position of said contactor bar, and upon further rotation of said main shaft, said overcentering means is placed in position to return the contactor bar to its first position, but is held from so doing by said latching means, said timing train thereafter functioning to remove the latching means from operative position after the expiration of a predetermined time interval.

2. A time-controlled switch comprising a pair of terminals, a contactor bar movable to connect and to disconnect said terminals, overcentering means for operating said contactor bar, a main shaft, means associated with said main shaft for engaging said overcentering means to operate the same during a fraction of the rotation of said main shaft, a main spring associated with said main shaft, and a timing train connected to said main shaft by a clutching means, means for manually rotating said main shaft, and latching means adapted to intercept the movement of said contactor bar, said latching means being operative according to the position of said main shaft, whereby, upon initial rotation of said main shaft, said overcentering means is actuated to change the position of said contactor bar, and upon further rotation of said main shaft, said overcentering means is placed in position to return the contactor bar to its first position, but is held from so doing by said latching means, said timing train thereafter functioning to remove the latching means from operative position after the expiration of a predetermined time interval, the extent of rotation of said main shaft determining the length of said time interval.

3. A time-controlled switch comprising a manually rotatable main shaft, an electric switch having open circuit and closed circuit positions, means associated with said main shaft and rotatable therewith operable upon rotation through a given angle to move said switch from one to another position, and upon rotation through a given greater angle to move said switch back to its first position, a latching mechanism operated by the rotation of said main shaft and interposable in the path of said first-named means thereby to prevent, temporarily, said switch from being returned to its first position, and a timing train operative after a predetermined time interval to remove said latching mechanism from the path of said first-named means to permit it to return said switch to its first position.

4. A time-controlled switch comprising a manually rotatable main shaft, an electric switch having open circuit and closed circuit positions, means associated with said main shaft and rotatable therewith operable upon rotation through a given angle to move said switch from one to another position, and upon rotation through a given greater angle to move said switch back to its first position, a latching mechanism operated by the rotation of said main shaft and interposable in the path of said first-named means thereby to prevent, temporarily, said switch from being returned to its first position, and a timing train operative after a predetermined time interval to remove said latching mechanism from the path of said first-named means to permit it to return said switch to its first position, said timing train including a main spring which is likewise connected to said main shaft to be empowered by the rotation thereof.

5. A time-controlled switch comprising a manually rotatable main shaft, an electric switch having open circuit and closed circuit positions, means associated with said main shaft and rotatable therewith operable upon rotation through a given angle to move said switch from one to another position, and upon rotation through a given greater angle to move said switch back to its first position, a latching mechanism operated by the rotation of said main shaft and interposable in the path of said first-named means thereby to prevent, temporarily, said switch from being returned to its first position, and a timing train operative after a predetermined time interval to remove said latching mechanism from the path of said first-named means to permit it to return said switch to its first position, said timing train including a main spring which is likewise connected to said main shaft to be empowered by the rotation thereof, the time interval during which said latching means is operable being directly proportional to the angle through which said main shaft is rotated.

MARCUS H. RHODES.