

March 8, 1960

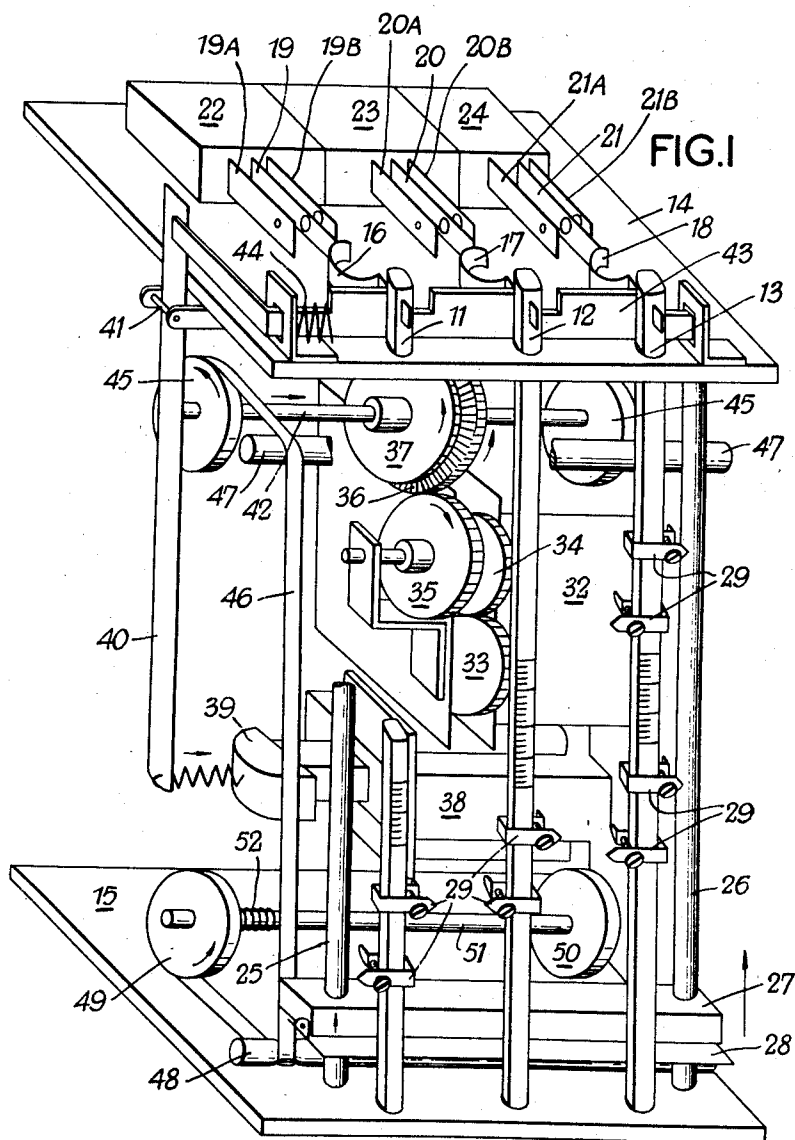
J. K. CHUCHLA

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TIMING MECHANISM FOR SWITCHES AND THE LIKE

Filed Sept. 12, 1958

3 Sheets-Sheet 1



INVENTOR.
JERZY KAZIMIERZ CHUCHLA

BY *Malcolm W. Farn*
ATTORNEY

March 8, 1960

J. K. CHUCHLA

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3 Sheets-Sheet 2

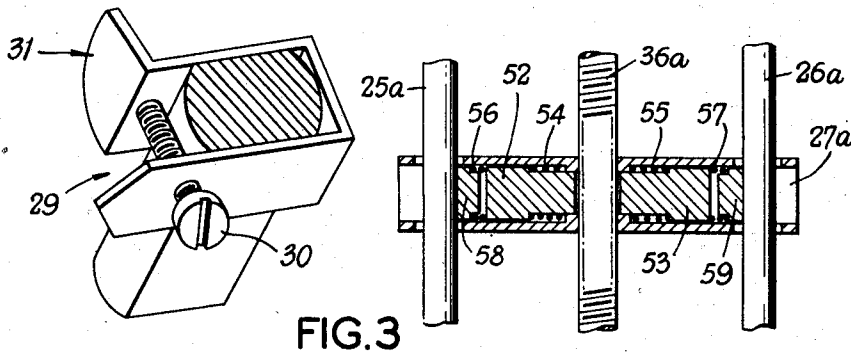


FIG. 2

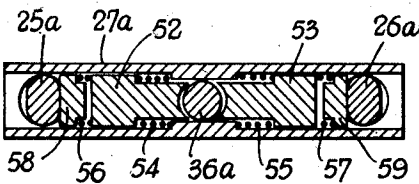


FIG. 4

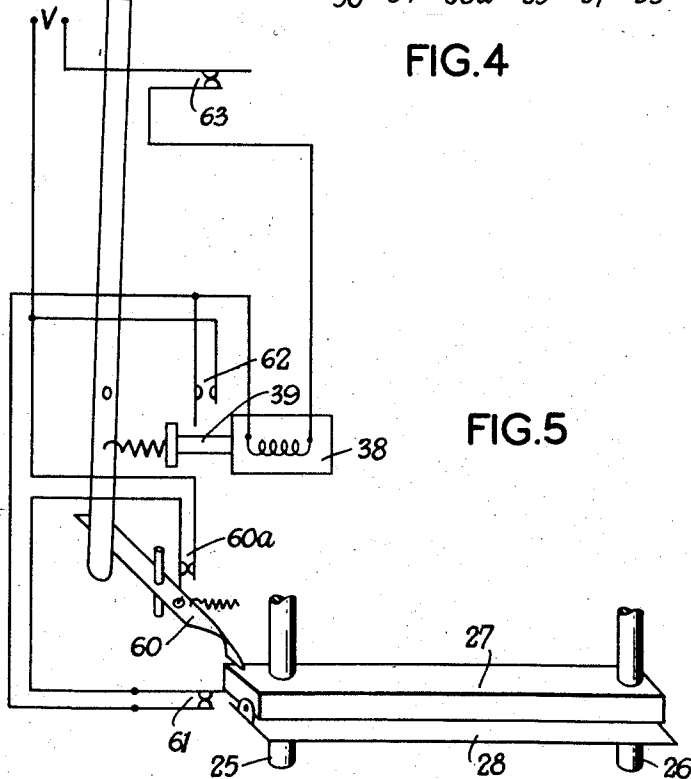


FIG. 5

INVENTOR.
JERZY KAZIMIERZ CHUCHLA
BY *Malcolm W. Finer*
ATTORNEY

March 8, 1960

J. K. CHUCHLA

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3 Sheets-Sheet 3

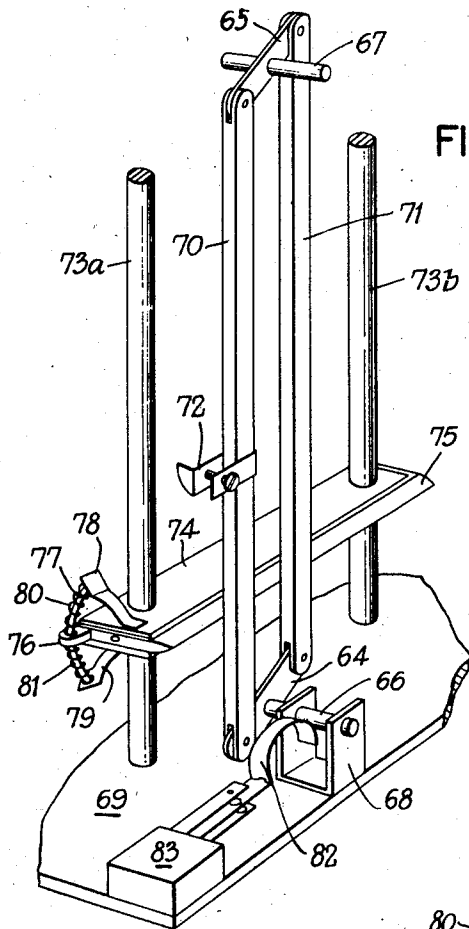


FIG.6

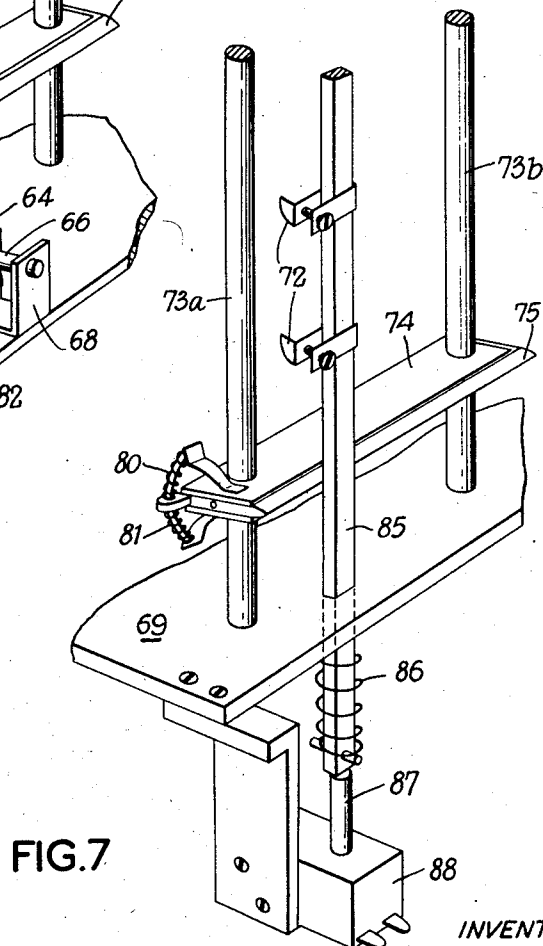


FIG.7

INVENTOR.
JERZY KAZIMIER CHUCHLA
BY *Malcolm W. Frances*
ATTORNEY

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TIMING MECHANISM FOR SWITCHES AND THE LIKE

Jerzy Kazimierz Chuchla, Harlow, England

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Claims priority, application Great Britain
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9 Claims. (Cl. 200—33)

This invention relates to timing mechanism for switches and the like, and in particular to timing mechanism of this kind which operates linearly, in the sense that parts of the mechanism which move relatively to one another and co-operate with one another in a certain relative position or positions to actuate a switch or the like are arranged to have a linear relative movement. Such an arrangement enables adjustment of the said co-operating parts, in order to control the time at which the switch or the like is actuated, according to a linear reference scale.

Timing mechanism is known in which a cam-follower is moved by a rotary cam, after a present amount of rotation of the cam, to actuate a switch; but adjustment of the cam to control the time at which the switch is actuated involves a circular measurement which is disadvantageous and which it is an object of the present invention to obviate.

According to the invention there is provided time-switch mechanism, including at least one elongate switch-operating member movable between first and second alternative rest positions, a two-position switch operatively connected with the switch-operating member and actuated thereby to assume its two positions according as the switch-operating member assumes the first and second of its two rest positions respectively, a trip member movable parallel to, and in the longitudinal direction of, the switch-operating member, means for moving the trip member at substantially constant speed from a starting end to a finishing end of the switch-operating member, secured to the switch-operating member between its starting and finishing ends, trip pins of a first series and of a second series of pins, respectively, each of which trip pins projects, when the switch-operating member is in the first and second, respectively of its two rest positions, into the path of the trip member and is engaged by the trip member during its travel from the starting end to the finishing end and by such engagement causes the switch-operating member to assume the second and first, respectively of its two rest positions, the arrangement being such that after movement of the switch-operating member into its said second and first, respectively rest positions, the trip member is free to pass the relative trip pin whilst leaving the switch-operating member in the said second and first respectively, rest positions.

Embodiments of timing mechanism according to the invention are described below with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic perspective view of a first embodiment of timing mechanism and of three switches controlled thereby,

Figure 2 is a perspective view, on an enlarged scale, of part of a rocking bar and of a trip pin comprised by the mechanism shown in Figure 1,

Figures 3 and 4 are respectively a cross section and a longitudinal section of part of a second embodiment of timing mechanism,

Figure 5 shows part of a wiring diagram for timing

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mechanism according to the invention by which the mechanism is adapted to repeat its cycle of operations indefinitely, and

Figures 6 and 7 illustrate diagrammatically parts of third and fourth embodiments of timing mechanism respectively.

The timing mechanism shown in Figure 1 comprises three similar switch-operating members, in the form of three rocking bars 11, 12 and 13, respectively, which are mounted between two spaced end-plates 14 and 15, to be independently rockable about their respective longitudinal axes. The upper end of each rocking bar is connected by means of a toggle spring 16, 17 or 18 respectively to the central contact blade, 19, 20 or 21 respectively, of one of three switches 22, 23 and 24 which are controlled by the mechanism. The effect of each toggle spring is to bias the rocking bar to which it is connected angularly into one of two rest positions between which, when urged against the bias, it rotates with a snap action, the central contact blade (19, 20 or 21) to which the toggle spring is also connected being correspondingly urged into contact with one or other of two other contact blades (19A, 19B, 20A, 20B, or 21A, 21B) between which it is mounted and to move angularly from one to the other with a snap action as the rocking bar rotates from one to the other of its rest positions.

Mounted parallel to the rocking bars, between the end plates 14 and 15, are two fixed guide bars 25 and 26 along which can slide a trip member comprising a block 27, apertured to receive the guide bars, and a trip plate 28 which is pivotable, as at 28A to a limited extent, on the block 27, and is preferably lightly urged towards the position shown in Figure 1 by spring means (not shown).

Each rocking bar 11, 12 and 13 has mounted on it a number of similar trip pins 29 which, as shown in Figure 2, are firmly but adjustably secured on the bar by means of screws 30. Each trip pin 29 is formed with a cam surface 31 which projects from the rocking bar on which the trip pin is mounted. As shown in Figure 1, the trip pins 29 are secured on each rocking bar in two series, all the trip pins having the cam surfaces 31 projecting towards the side of the bars on which the trip member (27 and 28) is mounted, but the cam surfaces 31 of one series being to the left, and of the other series being to the right, of the axes of the respective bars on which they are mounted. As a result, only one such series of trip pins is in the path of the trip member when all the rocking bars are in one of the two rest positions, and the other series is in the path when the bars are in the other rest position. As the trip member moves upwardly and engages a trip pin of one series, the rocking bar carrying that pin rotates with a snap action into its other rest position, and remains there during further movement of the trip member until a trip pin on the same bar and of the other series is engaged, whereupon the rocking bar snaps back into its initial rest position. In the illustrated arrangement this sequence is repeated twice for each rocking bar but may be made any chosen number of times, depending on the number and arrangement of trip pins on a bar. As the trip member moves downwardly, the trip plate 28 pivots on the bar 27, to allow free passage of the trip member without the rocking bars being disturbed.

In the mechanism shown in Figure 1, upward movement of the trip members 27 and 28 is effected by an electric motor 32 which through gears 33, 34 and 35 drives one plate 36 of a clutch, of which the other plate 37 is normally urged out of engagement. However, on energisation of a solenoid 38, a core 39 thereof is drawn in

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to pivot a lever 40 about its fulcrum 41 and move a shaft 42, on which the clutch plate 37 is mounted, to the right, so as to engage the clutch 37.

The lever 40 is normally biased to leave the clutch disengaged, by means of a projecting end of a bar 43 which is urged to the right (in Figure 1) by a spring 44. This bar 43 is notched to accommodate the toggle springs 16, 17 and 18 and in its normal position, i.e. when urged to the right, it bears against these springs so as to maintain each rocking bar in a chosen one of its two rest positions. However, when the lever 40 is pivoted by the solenoid it moves the bar 43 to the left, against spring 44, and the rocking bars 11, 12 and 13 are then free to be moved, subsequently, into their other rest positions.

When the solenoid is energised the clutch is engaged and two spools 45, which are mounted on the opposite ends of the shaft 42, are rotated at constant speed by the motor 32. Two tapes 46 which are each secured at one end to one of the spools 45 pass round guides 47 and 48 and are wound off a pair of spools 49 and 50, rotatable with a spindle 51 on which they are mounted. The tapes are each secured to the trip member block 27, which is therefore moved upwardly at constant speed as the tapes are wound on to the spools 45. The tapes are unwound from the spools 49 and 50 against the urging of a spring 52 which, when the clutch disengages, rewinds the tapes on the spools 49 and 50, returning the trip member to its lowest position.

Figures 3 and 4 show part of an alternative means for driving the trip member 27 and 28. In this alternative arrangement, the clutch, spools and tapes of Figure 1 are replaced by a lead screw 36a which is constantly driven by the motor 32 of Figure 1, and the solenoid 38 is arranged to twist, when energised, two guide bars 25a and 26a of non-circular cross-section, which replace the bars 25 and 26 of Figure 1 and on which is mounted a block 27a, which replaces the block 27 and through which the lead screw 36a passes. The block 27a houses two opposed half nuts 52 and 53 which are disposed one on each side of the lead screw 36a, and urged away therefrom by springs 54 and 55. Relatively strong springs 56 and 57, provided against the outer ends of the half nuts 52 and 53, urge two bearing members 58 and 59 against the guide bars 25a and 26a respectively. When the guide bars are rotated by the solenoid, the relatively weak springs 54 and 55 yield and the half nuts 52 and 53 engage the leadscrew 36a, so that the trip member begins its travel. The springs 54 and 55 do not normally yield, but allow the leadscrew to rotate to its correct angular position, relative to the half nuts, before these are moved into engagement. The block 27a is preferably provided with a pivotable plate 28 as shown in Figure 1, and is urged to its lowest position by spring means (not shown).

The motor 32 of Figure 1 is switched on and off independently of the remainder of the mechanism. With the trip member 27, 28 in its initial lower position as shown in Figure 1, and when the motor is already driving the clutch plate 36, the solenoid 38 is energised by closing a switch in a separate energisation circuit, this switch preferably being a normally-open switch and having in parallel with it a holding switch which is closed by the solenoid and remains closed so long as the solenoid is energised. The solenoid also causes the clutch 36, 37 to engage and the trip member 27, 28 to move upwardly at constant speed. The switches 22, 23 and 24 are thus opened and closed in dependence on the position at which the trip pins 29 are mounted on the rocking bars. These pins may be positioned in accordance with a linear time scale marked on the rocking bars 11, 12, 13 themselves as shown or adjacent thereto.

When the trip member reaches the upper end of the bars it engages and opens a normally closed switch (not shown) in the solenoid circuit, so that the solenoid becomes de-energised and the clutch disengaged, allowing

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the trip member to be returned by the spring 52, to its lower position. Alternatively, the said normally closed switch may be included in the circuit of the motor 32, which thereby stops, whilst the solenoid remains energised until its circuit is broken by manual operation of an additional switch. The trip member then remains in its upper position, and the motor remains inactive, until the solenoid is de-energised. In either case, the said normally closed switch may be replaced by one of the switches 22, 23 and 24, in which case the corresponding rocking bar will ordinarily have mounted on it only one trip pin 29, near its upper end. Whether the said normally closed switch is in the solenoid circuit or in the motor circuit, the mechanism will remain inoperative after it has completed its cycle once.

Figure 5 is a diagram of an alternative circuit which causes the mechanism to repeat its cycle of operations indefinitely once it has been initiated. The trip member 27, 28 is shown held in its starting lower position by a spring-urged lever 60 which permits the trip member to return at the end of its cycle but prevents it from bouncing back thereafter. The trip member and the lever 60, when in their illustrated positions, close two otherwise open switches 60a and 61, which, together with a further switch 63 which is normally closed, are in series with the solenoid 38 across a voltage V. Immediately the voltage V is applied, the solenoid 38 is energised and causes the lever 40 to pivot. This swings the lever 60 out of the path of the trip member 27, 28, which is moved upwardly as already described. The switches 60a and 61 therefore open, but a switch 62 in parallel with them is closed by the solenoid and provides a holding circuit. The trip member continues its upward movement until it engages and opens a switch 63, thus de-energising the solenoid so that the trip member is no longer driven upwardly and returns to its initial position. The lever 60 is also freed, and prevents the trip member from bouncing up on reaching its initial position; such bouncing would lead to error in the subsequent timing cycle. With the switches 60a and 61 closed again, the cycle is recommenced immediately and continues to repeat until the voltage V is switched off externally.

An alternative to the rocking bars 22, 23 and 24 is shown diagrammatically in Figure 6, which shows a switch-operating member in the form of a parallelogram linkage. This linkage comprises two rocking arms 64 and 65 rigidly attached to spindles 66 and 67 respectively, the spindle 66 being freely rockable in a bracket 68 mounted on a lower end plate 69, of which part is shown, and the spindle 67 being similarly mounted in a bracket (not shown) which is mounted on an upper end plate (not shown). Pivotaly mounted between the rocking arms 64 and 65 are two rods 70 and 71 on which are mounted, at appropriate points, trip pins 72 of which one tube is shown. Secured between the two end plates, parallel to the rods 70 and 71, are two guide bars 73a and 73b along which is slidable a block 74 of a trip member which is similarly driven, and functions similarly, to the trip member shown in Figure 1. Pivotaly mounted on the block 74 is a trip plate 75, a backwardly projecting lug 76 of which is freely slidable on an arcuate guide 77 which is secured between two supports 78 and 79 mounted on the block 74. A stiff spring 80 is mounted about the guide 77 between the lug 76 and the support 78, and a weaker spring 81 is similarly mounted between the lug 76 and the support 79. These springs normally maintain the trip plate 75 in the angular position shown in the figure.

The spindle 66 is biased to either one of two rest positions by a toggle spring 82 of which one end is connected to the central contact blade of a switch 83 which is controlled by the mechanism. In either of the two rest positions, the lower end of one or other of the rods 70 and 71 rests against the lower end plate 69.

As the trip member is moved upwardly, the trip plate 75 engages the pin 72 and due to the stiffness of the spring 80, causes the rod 70 to move upwardly, rotating the spindle 66 until it is caused by the toggle spring 82 to assume its other rest position, the switch 83 being simultaneously operated. The rod 71 now rests against the end plate 69, and further upward movement of the rod 70 is not possible. Therefore as the trip member continues to move upwardly, the spring 80 yields to allow the trip plate 75 to tip and pass the trip pin 72. If the trip plate subsequently engages a trip pin which is mounted on the rod 71, the spindle 66 is caused, in similar manner, to resume its initial position, and so on until the trip member has completed its travel. As the trip member is then returned to its lowest position, the spring 81, being relatively weak, allows the trip plate to rotate and pass the trip pins without disturbing the position of the switch-operating member.

It will be appreciated that the rods 70 and 71 move in the direction of travel of the trip member. If the trip pins 71 are positioned according to time scales marked on the rods themselves, this consideration is not important, but if the positioning is made with reference to scales fixed relative to the end plates, two relatively offset scales must be used.

Figure 7 shows part of a further alternative embodiment of timing mechanism according to the invention. In this embodiment, as in that shown in Figure 6, a trip member comprising a block 74 and a trip plate 75 biased to its normal position thereon by a stronger spring 80 and a weaker spring 81, is slidable by means not shown along two guide bars 73a and 73b which are rigidly mounted between a lower end plate 69 and an upper end plate (not shown). The parallelogram linkage shown in Figure 6 is here replaced by a bar 85 which is mounted in apertures of the upper and lower end plates so as to be slidable along its longitudinal axis, but non-rotatable about that axis. On the bar 85 are shown two trip pins 72, similarly mounted with respect to the bar 85 and the trip member, but spaced from one another along the bar. The bar 85 is urged downwardly by a spring 86 so that it normally lightly engages the end of a push-button 87 of a switch 88 secured to the lower end plate 69. The switch 88, whose push-button 87 is biased upwardly by means within the switch, is of the known kind in which a pair of contacts are alternatively closed and opened on alternate depressions of the push-button.

As the trip member is driven upwardly the trip plate 75 engages the lower of the two trip pins 72, and carries the bar 85 upwardly until the spring 86, under increasing compression, exerts a sufficient force to overcome the spring 80. The trip plate then tips to allow the trip pin 72 to pass it, and the bar 85 snaps downwardly, striking the push button 87 and thus operating the switch 88.

The spring 80 immediately returns the trip plate to its normal position, and the upper trip pin 72 is subsequently engaged in similar manner, to be released in turn so that the bar 85 again strikes the push-button 87 and the switch 88 is again operated, to restore it to its initial setting. As in Figure 6, the spring 81 is relatively weak, so that the trip member can subsequently be returned to its lowest position without displacement of the bar 85 and consequent operation of the switch 88.

It will be evident that the trip members of Figure 6 and Figure 7 may each actuate more than one switch-operating member and may therefore control the actuation of several switches in timed relationship, in an arrangement analogous to that shown in Figure 1.

What I claim is:

1. A time-switch mechanism, including at least one elongate switch-operating member movable between first and second alternative rest positions, a two-position switch operatively connected with the switch-operating member and actuated thereby to assume its two positions according as the switch-operating member assumes the first

and second of its two rest positions respectively, a trip member movable parallel to, and in the longitudinal direction of, the switch-operating member, means for moving the trip member at substantially constant speed from a starting end to a finishing end of the switch-operating member, secured to the switch-operating member between its starting and finishing ends, trip pins of a first series and of a second series of pins, respectively, each of which trip pins projects, when the switch-operating member is in the first and second, respectively of its two rest positions, into the path of the trip member and is engaged by the trip member during its travel from the starting end to the finishing end and by such engagement causes the switch-operating member to assume the second and first, respectively of its two rest positions, the arrangement being such that after movement of the switch-operating member into its said second and first, respectively, rest positions, the trip member is free to pass the relative trip pin whilst leaving the switch-operating member in the said second and first respectively, rest positions.

2. Mechanism as claimed in claim 1, including a pair of connected end plates, and wherein each switch-operating member is in the form of a bar mounted in the end plates so as to be rotatable, within limits, about its longitudinal axis.

3. Mechanism as claimed in claim 1, including an end plate, a parallelogram linkage mounted for reciprocation within limits on the end plate, opposite links of the parallelogram linkage constituting switch-operating members.

4. Mechanism as claimed in claim 1, including a pair of connected end plates and wherein each switch-operating member is in the form of a bar mounted in the end plates so as to be axially reciprocable.

5. Mechanism as claimed in claim 1, including a toggle spring bearing against each switch-operating member so as to urge it towards one of its positions of rest.

6. Mechanism as claimed in claim 1, including a toggle spring bearing against each switch-operating member so as to urge it towards one of its positions of rest, and wherein the movable member of the two-position switch is constituted by the toggle spring.

7. Mechanism as claimed in claim 1, wherein each switch-operating member is in the form of a bar and the pins of the first and second series of pins are mounted on the bar so as to project transversely therefrom and so as to lie respectively, in spaced parallel planes.

8. Mechanism as claimed in claim 1, including a pair of end plates and guide bars mounted in the end plates, wherein the trip member is in the form of a block slidable on the guide bars and a plate pivotally mounted on the block about an axis transverse of the elongate switch-operating member.

9. Mechanism as claimed in claim 1, including a clutch having a driving and a driven member, a constant speed motor drivably connected with the driving member of the clutch, a solenoid having its armature mechanically coupled with the clutch, drive means for the trip-member coupled with the driven member of the clutch, a source of energy for the motor and solenoid, and a switch in circuit between the source of energy and the solenoid, the arrangement being such that, upon closure of the switch, the solenoid is energised, the clutch is engaged and the trip member is driven at substantially constant speed from its starting end towards its finishing end.

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