

Sept. 6, 1966

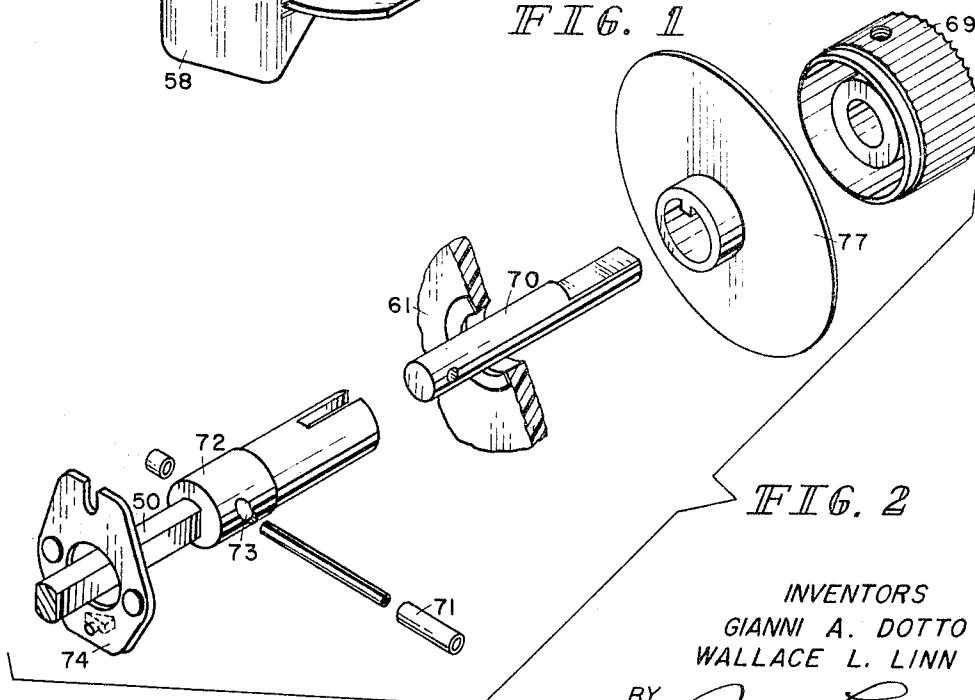
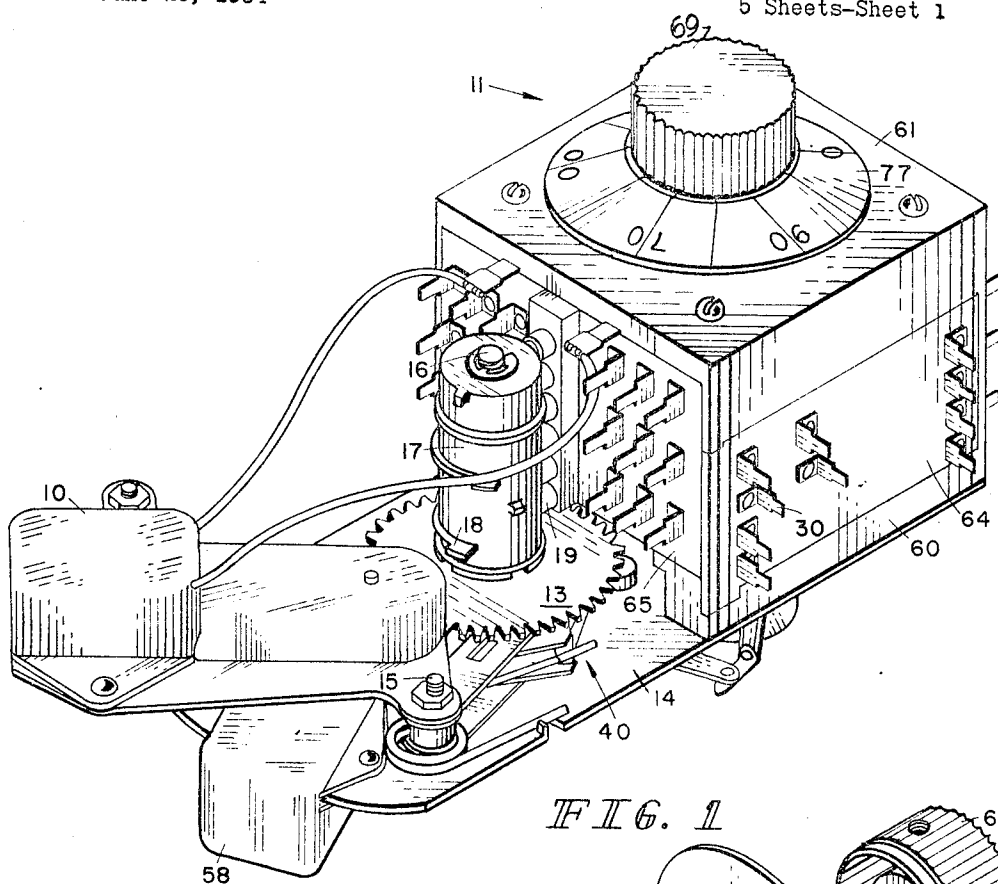
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3,271,541

MULTI-POSITION SNAP SWITCH

Filed June 29, 1964

5 Sheets-Sheet 1



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5 Sheets-Sheet 2

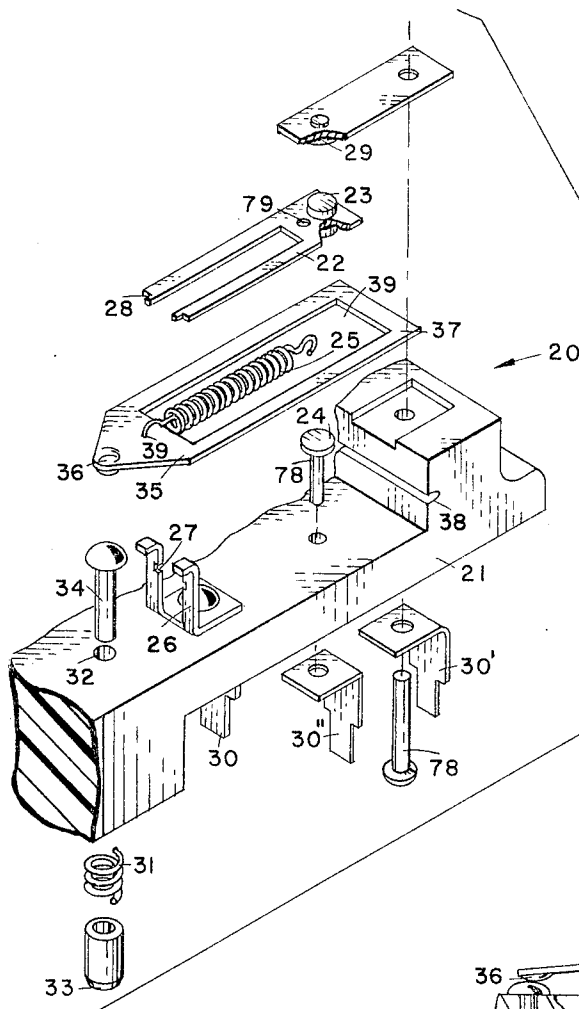


FIG. 3

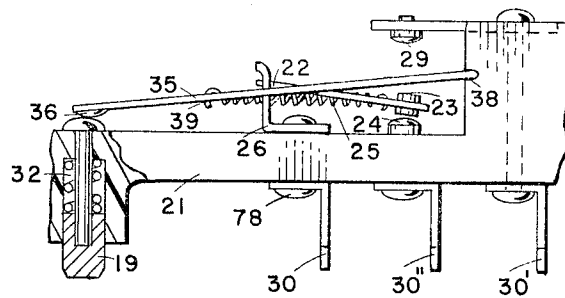


FIG. 4

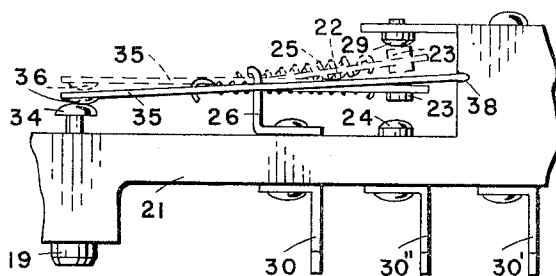


FIG. 5

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5 Sheets-Sheet 3

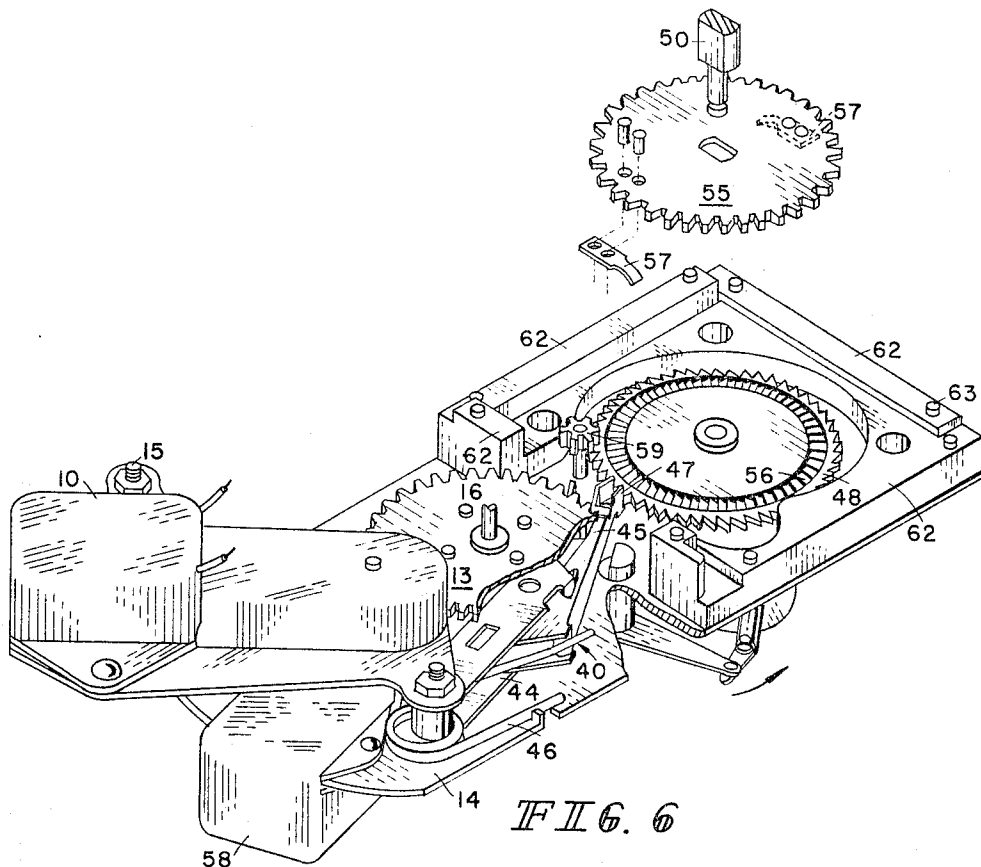


FIG. 6

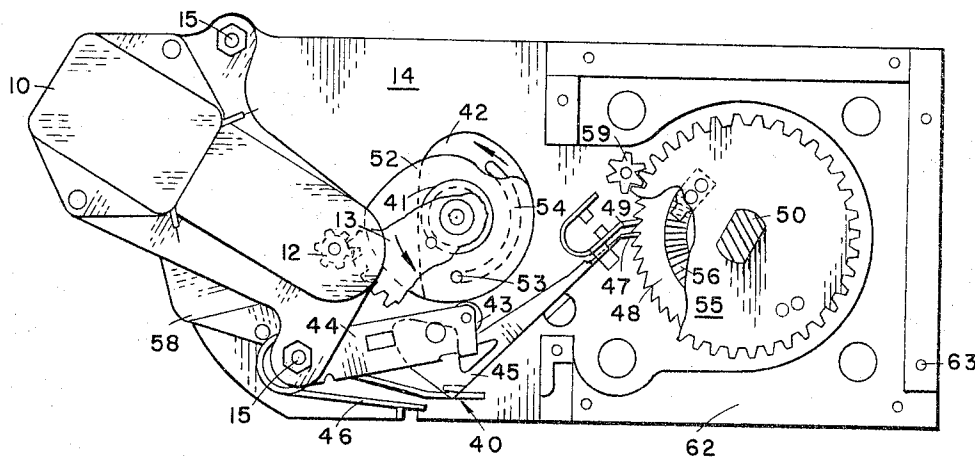


FIG. 7

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5 Sheets-Sheet 4

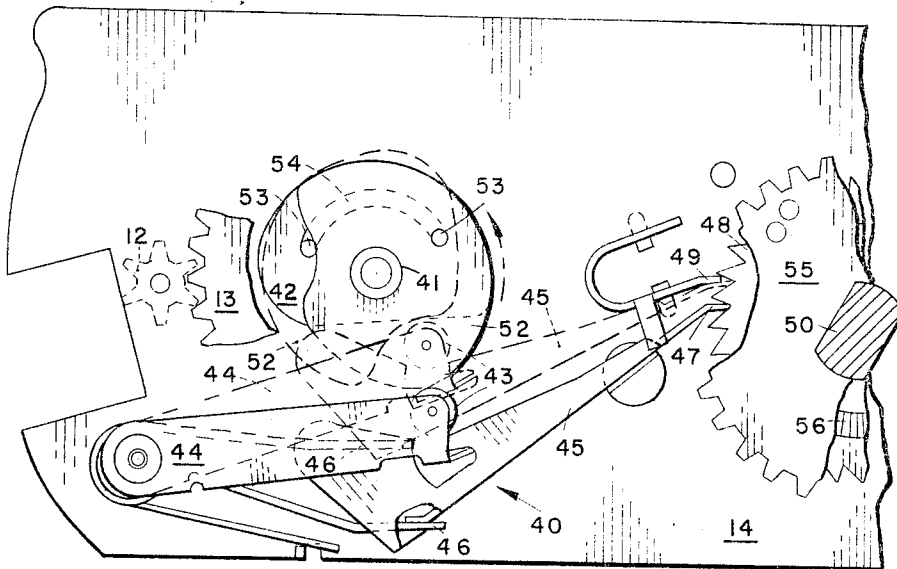


FIG. 8

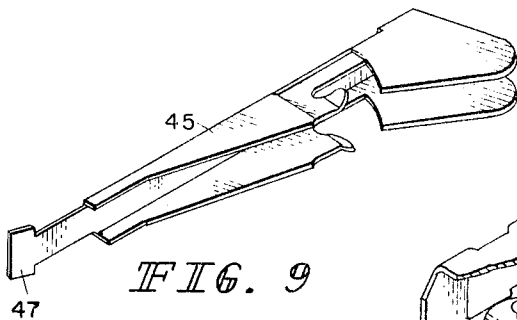


FIG. 9

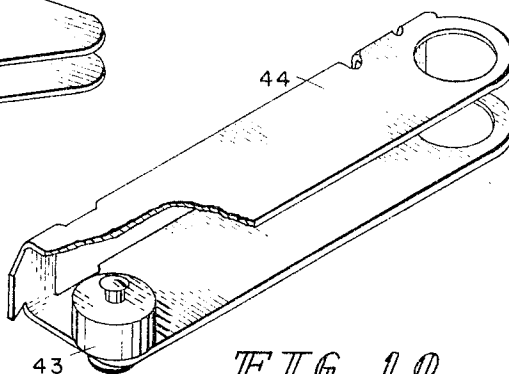


FIG. 10

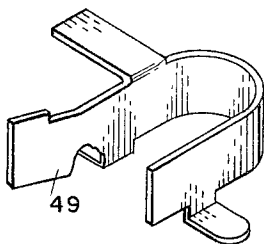


FIG. 11

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MULTI-POSITION SNAP SWITCH

Filed June 29, 1964

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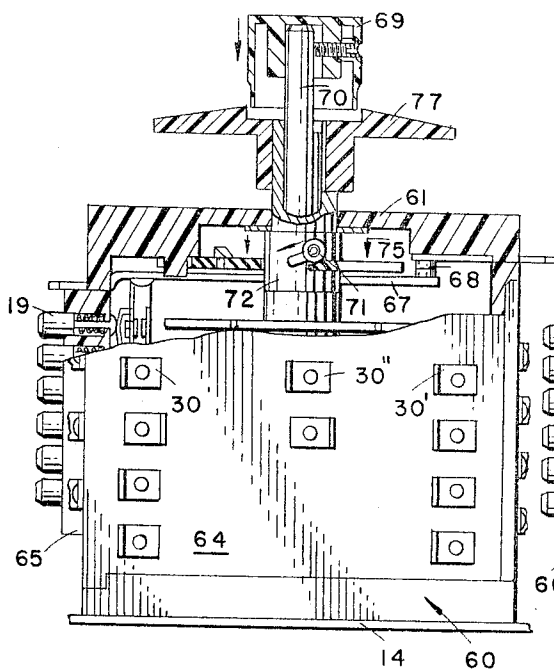


FIG. 12

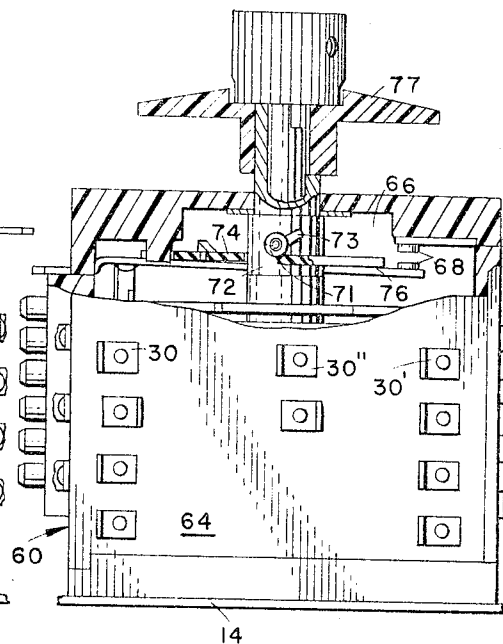


FIG. 13

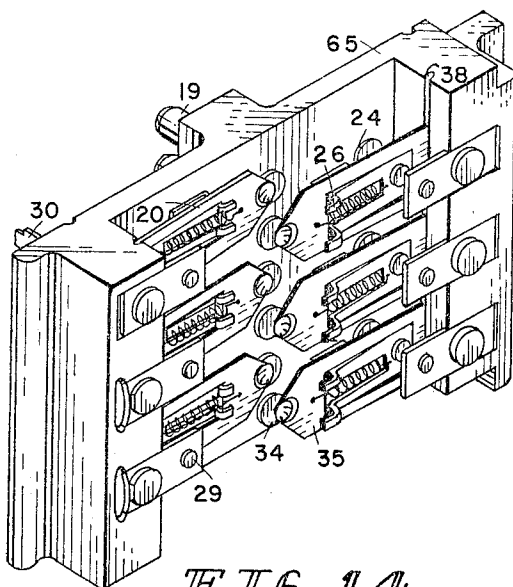


FIG. 14

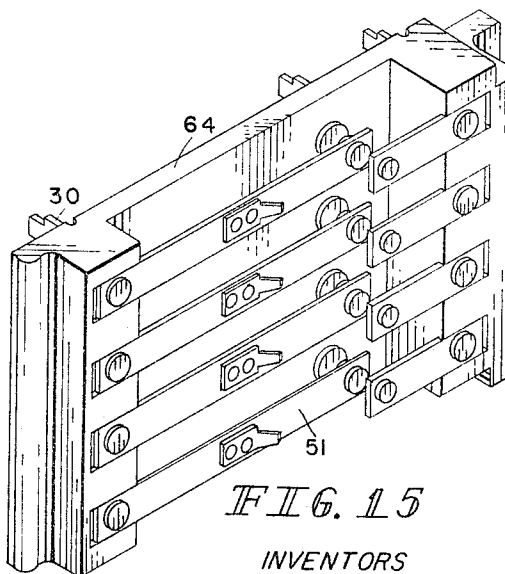


FIG. 15

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MULTI-POSITION SNAP SWITCH

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Filed June 29, 1964, Ser. No. 378,659
7 Claims. (Cl. 200—67)

The present invention relates to a novel sequential timer, more particularly to a sequential timer which is adapted to provide accurate and effective interval timing and sub-interval timing and which is adapted to actuate a relatively large number of electrical circuits.

There are sequential timers presently available that are utilized to actuate electrical circuitry at a predetermined interval of time and to deactivate electrical circuitry at the termination of a predetermined interval of time. The sequential timer of the present invention provides a novel follower switch that has snap action characteristics, the switch has two separate and distinct engaged positions and an open or neutral position; a novel interval advancement mechanism; a novel sub-interval mechanism; a novel knee action escapement; and a novel rapid advancement mechanism to rotate the sequential timer to a predetermined starting position. It is seen that the sequential timer has many different and varied uses, one of which is its utilization in a washing machine to regulate the cycling of the machine. As refinements are introduced to the washing machine making the washing machine commercially more desirable, the need arises to refine the sequential timers utilized to actuate the increased numbers of electrical circuits associated with the refined washing machine. Therefore, the necessity arises for a more accurate, simple, efficient, and effective sequential timer able to handle the increased number of electrical circuits, yet not occupy any great physical space than its predecessor sequential timer.

If the sequential timer must occupy a physical area no larger than prior art sequential timers yet be capable of handling increased numbers of electrical circuitry, design problems are encountered. The foremost design problem being that a minimum torque must be developed in order to have an accurate and effective sequential timer. It is seen that if the number of electrical circuits is increased, the torque needed to actuate the timer must increase, but the area in which the increased torque is developed remains substantially the same.

Therefore, it is an object of the present invention to provide a novel cam follower switch having two separate and distinct engaged positions and a neutral position or open position.

Another object of the present invention is to provide a sequential timer adapted to handle increased numbers of electrical circuits yet be retained in a relatively small physical package.

A further object of the present invention is to provide a novel follower switch having snap action characteristics that requires a relatively small torque to initiate operation thereof.

A still further object of the present invention is to provide a novel follower switch having snap action characteristics, the switch possessing a tension spring to actuate a follower blade to one of three predetermined positions including a neutral or open position which tension spring provides more positive action than heretofore thought possible.

Yet another object of the present invention is to provide a means and method whereby the follower switches on a particular side of a sequential timer are interchangeable with the follower switches on any other side of the sequential timer.

Another object of the present invention is to provide a follower switch, having snap action characteristics, the switch possessing a tension spring that insures uniform pressure between movable contacts and fixed contacts of the follower switch.

Still another object of the present invention is to provide a simple, efficient, and practical multi-position snap switch.

Yet another object of the present invention is to provide a multi-position snap switch having optimum reliability characteristics afforded by a compact construction having a minimum number of parts.

The present invention in another of its aspects, relates to novel features of the instrumentalities of the invention described therein for teaching the principal object of the invention and to the novel principles employed in the instrumentalities whether or not these features and principles may be used in the said object and/or in the said field.

With the aforementioned objects enumerated other objects will be apparent to those persons possessing ordinary skill in the art. Other objects will appear in the following description, appended claims, and appended drawings. The invention resides in the novel construction, combination, arrangement, and cooperation of elements as hereinafter described and more particularly as defined in the appended claims.

The appended drawings illustrate several novel and different embodiments of the present invention, constructed to function in the most advantageous modes devised for the practical application of the basic principles involved in the hereinafter described invention.

In the drawings:

FIGURE 1 is a perspective view of an embodiment of the present invention illustrating the sequential timer and its associated driving means.

FIGURE 2 illustrates the manual means operable to modify the duration of or sequence of the operation of the sequential timer embodied in the present invention.

FIGURE 3 is an enlarged perspective view of the follower switch having snap action characteristics embodying the basic principles of the present invention.

FIGURE 4 is an enlarged side view of the follower switch having snap action characteristics of the present invention wherein said switch contacts are at an initial location.

FIGURE 5 is an enlarged side view of the follower switch having snap action characteristics illustrating movement of the contact carrying blade just prior to and just subsequent to movement by said blade from a neutral position or open position to an engaged position illustrated in full and dotted lines respectively.

FIGURE 6 is a partial perspective view of the present invention illustrating the escapement, slow running means and fast running means and the interrelationship therebetween.

FIGURE 7 is a partial top view of the present invention illustrating the novel knee-action escapement of the present invention.

FIGURE 8 is an enlarged top view of the escapement illustrating movement of the escapement just prior to and just subsequent to movement by the escapement.

FIGURE 9 is an enlarged perspective view of the rigid arm of the escapement.

FIGURE 10 is an enlarged perspective view of the follower arm of the escapement.

FIGURE 11 is an enlarged perspective view of the pawl of the escapement.

FIGURE 12 is a side view partially cut away to illustrate the location of the manually operable means with respect to the follower switches at a particular first instance of time embodied in the present invention.

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FIGURE 13 is a side view partially cut away to show the location of the manually operable means with respect to the follower switches at a particular second instance of time.

FIGURE 14 is an enlarged perspective view of the present invention illustrating in detail a plurality of follower switches having snap action characteristics.

FIGURE 15 is an enlarged perspective view of the present invention particularly illustrating an interchangeable plurality of follower switches.

Generally speaking the means and methods of the present invention relate to a sequential timer for predeterminedly actuating electrical circuitry. The timer includes a mounting bracket to provide supporting structure, an electrical driving means, a sub-interval means, an escapement means, a plurality of sequentially cam operated switches, and a rotatable time selector-indicator means.

The electrical driving means is an electrical motor that mechanically drives a pinion, which pinion meshes with and thereby rotatably drives a gear at a constant, predetermined speed.

A sub-interval means having a cyclic duration proportional to the peripheral speed of the gear since the coded cams of the sub-interval means are carried by and fixedly coupled to the gear. The coded cams are aligned with a plurality of plungers in such a manner that the plungers follow the coded indicia of the cams. The movement of the plurality of plungers is transferred to a plurality of follower switches that have snap action characteristics. Each follower switch having snap action characteristics includes a retaining means and an actuator coupled together at corresponding extremities. The actuator includes an opening formed in its longitudinal axis. A contact carrying blade is positioned within the opening, the blade having an extremity pivotably coupled to the retaining means. A tension spring has one extremity coupled to the actuator and a second extremity coupled to the blade, the tension spring pivotably displaces the blade to a position of equilibrium with the actuator as the actuator is displaced from its normal position. The contact carrying blade has at least three positions; two of the positions being alternate engagement between two separate and distinct fixed electrically conductive contacts and a neutral or open position whereby the blade is not in contact with either of the fixed contacts.

An escapement is coupled to the gear that is fixedly coupled to the sub-interval means. The gear is coupled to a hollow shaft to which a fixed drive cam is fixedly coupled. A partial cam is loosely coupled to the hollow shaft so as to have floating characteristic thereon. The drive cam has an arcuate slot of predetermined length cut therein, and the partial cam has a pin which interfits with the slot and movable along with the slot. The peripheries of the drive cam and the partial cam having the floating characteristic are coded with indicia or rise and fall contours. A tension spring biased follower arm rides on the peripheries of the cams reacting to the coded indicia thereon. A rigid arm is coupled to the follower arm in a hinged fashion to intermittently actuate a ratchet associated with a cam shaft in accordance with the intermittent forward motion of the rigid arm. The cam shaft has fixedly coupled thereon a plurality of cams which sequentially operate a plurality of follower switches.

The rotatable time selector means includes a dial fixedly coupled thereto which indicates the sequence of operation the timer is experiencing at any interval of time and a means to disconnect the sequential timer from an electrical power source. The means utilized to disconnect the sequential timer include a first shaft and a pin fixedly coupled to and perpendicular to the longitudinal axis of the first shaft. A slot in the hollow shaft interfits with the pin of the first shaft and is movable along the slot. A resilient cam underlies the pin, accord-

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ing as the pin is displaced downwardly by the rotation of the shaft, the resilient cam is likewise displaced downwardly in proportion to the displacement of the pin. A contact carrying resilient arm is movable with the resilient cam. In the normal position the contact carrying arm is engaging with a fixed contact so as to couple the sequential timer to an electrical power source. As the contact carrying arm is moved downwardly by the action of the pin and the resilient cam, the contact arm disengages the fixed contact thereby breaking the electrical circuit between the sequential timer and the electrical power source. When the pin engages the lower portion of the slot, the co-axial shafts will rotate each with the other permitting the cam shaft to be located at any desired position within a cycle while the timer is deenergized.

Referring now to the drawings, which illustrate the preferred embodiment of the present invention, the sequential timer means is generally indicated by numeral 11. The vital components of the aforementioned sequential timer means includes a driving motor 10 which is mechanically coupled to pinion 12 to rotate the pinion in a clockwise direction with substantially continuous rotary motion. Motor 10 is secured to mounting bracket 14 by bolts 15 to prevent horizontal and vertical displacement of the motor due to vibration or abusive handling. Bolts 15 predeterminedly locate pinion 10 with respect to gear 13 such that gear 13 meshes with and is driven by pinion 12 in a counter-clockwise direction with a substantially continuous rotary motion. A shaft 16 is fixedly seated in mounting bracket 14. Shaft 16 extends upwardly from the mounting bracket and projects through the axis of and therefore carries thereon rotatable gear 13. Mounted immediately above gear 13 is rotatable cam means 17. Shaft 16 extends through the longitudinal axis of the cam means in such a manner that the cam means is rotatably coupled to rotate about the axis of the shaft.

Cam means 17 includes thereon a plurality of predeterminedly spaced peripheral cam tracks 18. Each peripheral cam track includes therein coded indicia of rise and fall contours which indicia is utilized to displace plungers 19 to one of three predetermine positions dependent on which portion of the coded indicia the plungers are riding. It is seen that plungers 19 are located juxtaposition peripheral cam tracks 18 in such a manner that a plunger is associated with a cam track. As cams 17 are rotated by motor 10, plungers 19 riding on cam tracks 18 are displaced to one of three predetermine positions, the positions being determined by the coded indicia of the particular cam track, upon which the plungers are riding.

Follower switch 20 with snap action characteristics is secured to bracket 21 by means of rivets 78. A C-shaped blade 22 carries thereon electrical contact 23. Blade 22 is normally biased to engage lower contact 24 fixedly mounted in bracket 20. Tension spring 25 acts on blade 22 to normally bias the blade in a downward direction. A U-shaped retaining means 26 is coupled to bracket 21 in such a manner to serve as a positioning and a retaining means for blade 22 and actuator 35. Each leg of retaining means 26 has a notch recessed portion 27 which interfits with a notched portion 28 located at the extremity of each leg of C-shaped blade 22 in such a manner that when blade 23 is displaced upwardly toward upper fixed contact 29, the notched portion 28 of blade 22 pivots utilizing the recess portion 27 as a pivot point. Movable contact 23 is electrically coupled to an electrical terminal 30, whereas fixed contact 29 is electrically coupled to electrical terminal 30', and whereas fixed contact 24 is electrically coupled to electrical terminal 30''. It is seen that the electrical terminals are coupled to any one of the multiple electrical circuits associated with a sequential timer. The location of movable contact 23 would govern whether particular

circuits associated with follower switch 20 are electrically actuated or electrically deactuated. As disclosed hereinbefore plunger 19 rides on the peripheral cam track 18 and translates the coded indicia thereon to a mechanical movement. Plunger 19 includes three portions as follows: a spring bias means 31 that interfits with aperture 32 of bracket 30 which downwardly spring biases node 33 into engagement with track 18. A rivet shaped pin 34 interfits with node 33 in such a manner that an upward deflection of the node will cause pin 34 to be deflected upwardly. An actuator 35 is positioned such that an extremity 36 overlies and is movable with the head portion of rivet shaped pin 34. The extremity 37 of actuator 35 opposite extremity 36 interfits with notched portion 38 of bracket 20. It is seen that notched portion 38 serves as a point about which actuator 35 pivots. Actuator 35 is fabricated of substantially flat, rigid metal and is substantially elongated in shape. Formed within the actuator is opening 39. Mounted within opening 39 and movable therethrough is C-shaped blade 22 which is fabricated of electrically conductive, yet rigid material. Because of the thinness of blade 22 and the positioning of notched portions 28 on the legs of the blade, the blade is allowed to pivot with respect to retaining means 26, the retaining means providing the pivot point. The blade is held in its pivotable engagement with respect to means 26 by means of tension spring 25 which spring is positioned in opening 39 of actuator 35 with one end portion coupled to extremity 36 as at 39 of the actuator and the opposite end extending through the legs of the C-shaped blade with said extremity coupled as at 79 to the blade 22.

The follower switch with snap-action characteristics operates in the following manner. Cam track 18 has riding on the periphery thereof a spring biased plunger 19 which plunger follows the coded indicia, the rise and the fall contours, of the cam track. When plunger 19 is displaced upwardly through aperture 32 by the coded indicia of the cam track, rivet shaped pin 34 of the plunger is likewise displaced upwardly exerting an upwardly acting force on extremity 36 of actuator 35. Tension spring 25 normally bias C-shaped blade 22 downwardly. As point 39 of actuator 35 is displaced upwardly, the downwardly acting force of tension spring 25 becomes less and in fact becomes an upwardly acting force on blade 22 as point 39 approaches the horizontal plane of notched portion 38 of bracket 20. As disclosed hereinbefore notched portion 38 is the point about which actuator 35 pivots. When point 39 moving upwardly comes within several hundredths of an inch of the horizontal plane of notched portion 38, the now upwardly acting force of tension spring 25 displaced C-shaped contact carrying blade 22 upwardly with a rapid motion until point 39, tension spring 25, and blade 22 are again in equilibrium which occurs prior to point 39 falling within the horizontal plane of notched portion 38. It is seen that the switch assumes a neutral or open condition for no electrically conductive circuit is formed between any two of the external contacts. The open condition can be maintained as long as the coded indicia on the cam track so dictates. When the extremity of the actuator is displaced upward by the coded indicia of the associated cam track acting through the plunger, the displacement of point 39 upwardly causes the tension spring to exert an upwardly acting force against blade 22. Here the blade linearly follows the displacement of point 39 until the point is past the horizontal plane of notched portion 38 by several hundredths of an inch, thereafter the upward displacement of the blade is rapid when compared to the linear upward displacement of point 39 to engagement by movable contact 23 of blade 22 with stationary contact 29. When the coded indicia of track cam 18 permits extremity 36 to return to its normal position, the interaction of actuator 35, tension

spring 25, and blade 22 is substantially the same as described hereinbefore.

Each cam track may have various length segments so as to provide the necessary "on," "neutral" and "off" periods of time for the electrical circuit controlled by that particular cam track.

The escapement incorporated into the novel sequential timer 11 of the present invention is shown by numeral 40. The driving motor 10 is mechanically coupled to pinion 17 so as to drive the pinion in a clockwise direction. The pinion meshes with and therefore rotatably drives gear 13 in counter-clockwise direction. Gear 13 is retained by shaft 16 in such a manner that the shaft determines the axis about which the gear rotates. Gear 13 is staked to a short hollow shaft 41 that interfits with and is co-axial with shaft 16. Likewise a drive cam 42 is staked to shaft 41, but is staked to an extremity of shaft 41 that is opposite to the extremity to which gear 13 is staked. Thus gear 13 and drive gear 5 are separated by a predetermined distance, which distance is the axial length of the hollow shaft. It is seen that as drive motor 10 rotatably drives gear 13 that drive cam 42 follows the rotational displacement of the gear in the counter-clockwise direction. The periphery of the drive cam has a predetermined rise characteristic and a predetermined fall characteristic located each at a desired location on the drive cam. A roller 43 is rotatably coupled to a follower arm 44 such that the displacement of the roller causes a corresponding displacement of the follower arm. As shown in the drawings, follower arm 44 pivots about an axis determined by retaining bolt 15. As roller 43 approaches apex of the cam surface of the driving cam, the follower arm is displaced outwardly from shaft 16, such displacement causes a rigid arm 45, that has an extremity pivotably coupled to an extremity of the follower arm, to be displaced outwardly from shaft 16. The movement outwardly by rigid arm 45 causes a tension spring 46 to be displaced to a position further removed from shaft 16, thus accumulating and storing energy. The outward movement of rigid arm 45 causes the driving end 47 of the rigid arm to move from close proximity of first tooth valley of ratchet to close proximity of a valley of an adjacent tooth. It is seen that the driving end is displaced in the counter-clockwise direction with respect to the periphery of ratchet 48. Pawl 49 is positioned to provide a guide for rigid arm 45 and to provide a means to prevent ratchet 48 from being displaced in the counter-clockwise direction. As the roller moves just beyond its peripheral apex of the rotating drive cam, rapidly moves to the valley or the point on the periphery of the drive cam that is the closest to shaft 16. The energy stored in tension spring 46 is released and acts downwardly on rigid arm 45 driving the rigid arm to its initial position with respect to follower arm 44. By the rigid arm returning to its initial position with respect to the follower arm, the ratchet is driven in a clockwise direction equal to the angular distance of a ratchet tooth. Each cycle of the gear and cam combination indexes a single tooth of the ratchet which, in turn, imparts substantially the same incremental clockwise displacement to cam shaft 50. Cam shaft 50 has fixedly coupled thereto a plurality of cams (not shown) that are utilized to sequence the operation of associated follower switches 51.

It is seen that overthrow problems are developed when roller 43 falls along the periphery of the drive cam toward the axis of shaft 16. The rapid fall allows tension spring 46 to release its stored energy more rapidly than desired thereby rotating the ratchet beyond the desired one tooth advancement. To overcome this defect and other harmful effects a floating partial cam 52 which includes a pin 53 movable within slot 54 of drive cam 42. The number of incremental operations of escapement 40 is dependent on the number of falls the follower arm experiences during any given interval of time.

As disclosed hereinbefore pinion 12 rotates in the clockwise direction, driving gear 13 in the counter-clockwise direction. Gear 13 is staked to one extremity of shaft 41, whereas drive cam 42 is staked to the opposite extremity of shaft 41. Rotation of gear 13 displaces cam 42 in a counter-clockwise direction, the periphery of the cam displaces roller 43 in accordance with the rise and fall contours or the coded indicia of the periphery of the cam. Cam 42 remains in engagement with roller 43 for approximately 120 degrees of the drive cam's periphery at which point the roller is transferred to the periphery of partial cam 52. At the point of transfer an extremity of slot 54 of drive cam 42 engages the pin projection of the partial cam, thereby inducing the partial cam to effect the transfer of the roller and the remainder of the rise cycle of the follower arm is transmitted to the roller. It is seen that the contour of the periphery of the partial cam continues to rise or displace the roller further from its initial position.

The fall portion of the periphery of the partial cam is subsequent to the apex of the periphery of the cam. Upon the roller passing the apex of the partial cam, the roller travels down the incline of the partial cam, which action moves the partial cam in the counter-clockwise direction approximately 135 degrees which is the length of slot 54 in terms of degrees. Thereafter, the rollers are allowed to fall to the lowest most contour on the periphery of the drive cam. This prevents the partial cam from having any effect on the displacement of roller 43 until the 120 degree transfer point is attained as described hereinbefore. The fall incline of the partial cam is designed to impose a retarding action to the fall of the roller due to the locking action effect that exists in such a construction. It is seen that the roller has to force the partial cam to rotate at the fall point by utilizing pressure. The fall is delayed a sufficient period of time to prevent overthrow of the ratchet by decreasing the straightening action of rigid arm 45.

FIGURE 12 is an enlarged top view of the escapement illustrating the movement of the escapement at the instant of time just prior to and the instant of time just subsequent to the intermittent movement by ratchet 48. The escapement and in dotted lines to illustrate the position and location of pertinent escapement components after the intermittent motion has occurred.

Axially aligned with and overlying ratchet 47 is gear 55. Ratchet 47 has cut in the surface underlying gear 55 a circle of ratchet teeth 56 that has its axis shaft 50. Since gear 55 is held in a predetermined position with respect to shaft 50, predeterminedly spaced resilient extensions 57 securely coupled to gear 55 by any suitable means interfit with the valley portions of at least two of the ratchet teeth 56. As escapement 40 imparts intermittent motion to ratchet 48, the resilient extensions 57 are displaced in a corresponding intermittent motion. It is seen that since the resilient extensions are securely coupled to gear 55, gear 55 is likewise displaced with intermittent motion. Cam shaft 50 is coupled to gear 55 in such a manner that the cam shaft follows the intermittent motion of the gear 55. Coupled to cam shaft 50 is a plurality of cams containing on the periphery thereof coded indicia necessary to provide the appropriate sequential operation of the associated electrical circuitry.

The present invention incorporates therein a rapid advance mechanism comprised of high speed driving motor 58, a pinion 59 mechanically coupled to the armature of motor 58, and gear 55. It is seen that pinion 59 meshes with and therefore drives gear 55 in the clockwise direction. Motor 58 is coupled to gear 55 through pinion 59 which when the motor is electrically actuated, it will drive the gear at a much more rapid rate in the clockwise direction than escapement 40 will rotate gear 55. Resilient extensions 57 are so constructed so as to be overriding ratchet teeth 56 if gear 55 is actuated by high speed drive motor 58. By utilizing the high speed motor to rotate gear 55 in the clockwise direction, the sequential timer is

provided with a means and method of rapid advance of the cams attached to shaft 50. To remove the influence of the rapid advance influence of motor 58, the motor is simply electrically deenergized, allowing escapement 40 to be the actuation means for clockwise movement of gear 55 and associated cam shaft 50. It is seen that if cam shaft 50 was manually rotated in the clockwise direction, resilient extension 57 would yield under the pressure of ratchet teeth 56 whereas if an attempt was made to manually rotate cam shaft 50 in the counter-clockwise direction the extensions lock with ratchet teeth 56 so as to prevent counter-clockwise displacement of cam shaft 50.

The follower switches and the cam shaft 50 and its associated cams are mounted within housing 60. Electrical interconnections between the follower switches and the electrical circuitry of a particular washing machine may be provided as desired to adopt the sequential timer to a particular washing machine. Likewise the coded indicia of the cam tracks is selected to effect the desired control program.

The housing 60 is comprised of a mounting bracket 14 which predeterminedly positions the housing with respect to the drive motors and the escapement, a top plate 61 having an aperture through which cam shaft 50 projects and four side walls comprised of three walls of a plurality of follower switches and a fourth wall of a plurality of follower switches that have snap action characteristics, as shown in FIGURE 14 and FIGURE 15 respectively. The side walls of the housing are arranged in four quadrants. It is seen that the cam follower 51 makes a substantially radial line of engagement with the coded indicia of the cams located on cam shaft 50. The housing is so designed that a cam associated with cam shaft 50 is associated with each of the cam followers 51 so as to periodically actuate the cam followers as the cam shaft is intermittently rotated. Mounting bracket 14 is provided with a stair step seat 62 which permits any one of the three side walls 64 containing a plurality of follower switches 51 as illustrated in FIGURE 15 to be interchanged each with the other and permit proper mating with the appropriate actuating cam. Pins 63 locate the side walls 64 in the horizontal plane with respect to mounting bracket 14.

Housing 60 includes a four wall 65 that comprises a plurality of follower switches having snap action characteristics 20 as illustrated in FIGURE 14. The plunger of switch 20 is positioned on the outer periphery of side wall 65 juxtaposition cam 17 as illustrated in FIGURE 1. As disclosed hereinbefore, gear 13 to which cams 17 are fixedly coupled are rotated at a constant speed rather than with an intermittent motion due to the substantially direct coupling to drive motor 10. It is seen that gear 13 is an element associated with escapement 40 and as such the cams associated with gear 13 will actuate the plurality of switches 20 throw a complete cycle for each intermittent movement initiated by the escapement. The plurality of switches 20 comprising wall 65 is coupled to electrical circuitry which is desired to provide a sub-interval for the sequential timer.

A line off-on switch mechanism 66 is provided to prevent actuation of electrical circuitry associated with the sequential timer when cam shaft 50 of the timer is manually rotated through undesired portions of the cycle of the timer. An off-on switch 67 including main line contacts 68 each electrically coupled to the electrical power supply, will couple the main power source to the timer when the respective contacts are in the engaged position as illustrated in FIGURE 12 and will disconnect the main power source from the timer when the contacts are in the open position as illustrated in FIGURE 13. A manually rotatable knob 69 is fixedly coupled to an extremity of rotatable shaft 70 by any suitable means. In close proximity to the extremity of shaft 70 opposite knob 69, a pin 71 is fixedly mounted perpendicular to the longitudinal axis of the shaft. A portion of shaft 70

containing pin 71 interfits with and is co-axial with hollow shaft 72. Hollow shaft 72 is fixedly mounted to an extremity of cam shaft 50 such that rotational displacement of shaft 72 initiates a like rotational displacement of the cam shaft. Pin 71 interfits with and projects through a slot 73 cut in hollow shaft 72 and at substantially a 45 degree angle with the longitudinal axis of the hollow shaft. Abutting pin 71 is resilient cam 74 which cam has an extremity fixedly coupled to the underside of top plate 61 of the housing. It is seen that as pin 71 follows the contour of slot 73, resilient cam 74 will follow the horizontal displacement of the pin. Since slot 73 is at substantially 45 degree angle with the longitudinal axis of hollow shaft 72 and manual rotation of knob 69 in the clockwise direction will displace pin 73 clockwise and downwardly. Pin 71 will displace cam 74 downwardly as indicated by arrow 75. During the downward movement of cam 74, it will engage resilient and electrically conductive arm 76 which arm carries one of the main line current contacts 68. Upon further displacement downwardly of cam 74, resilient arm 76 is displaced downwardly ultimately separating electrically conductive contacts 68 each from the other thereby disconnecting the sequential timer from the source of electrical power used to energize the timer. Upon abutting the lowest most extremity of slot 73, pin 71 engages hollow shaft 72 and thereafter further rotation of knob 69 in the clockwise direction will cause shaft 72 and fixedly coupled cam shaft 50 to be rotationally displaced in the clockwise direction. It is seen that since the power source energizing the sequential timer is disconnected from the timer, a particular portion of a timing cycle can be selected manually without electrically energizing functions of the timer that it is desired to eliminate from a particular timing cycle. A dial 77 has printed on the upper surface thereof indicia indicative of a particular portion of the timing cycle at which the timer can be positioned or is presently positioned. Manually rotating knob 69 in the counter-clockwise direction permits resilient cam 74 to return to its normal position of non-engagement with contact carrying arm 76, thus allowing main line contacts 68 to electrically engage. Upon engagement contacts 68 electrically couple the sequential timer to the main line electrical power source which energizes the timer. The timer thereafter begins its cycle at this predetermined starting point.

While the invention is illustrated and described in its preferred embodiment, it will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of this invention and as set forth in the appended claims.

Having thus described my invention, I claim:

1. A snap action switch means having first, equilibrium and third positions comprising: a mounting means; a means mounted on said mounting means, said means including members extending therefrom; an actuator means having an extremity coupled to said mounting means, said actuator means slidably interfitting with said members and extending therebeyond; a contact carrying blade pivotably coupled to said members; energy storage means connected to said blade and to said actuator means and extending through the plane of said members, said actuator means slidably displaced along said members by a condition thereby causing pivotable displacement of said blade through said energy storage means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

2. A snap action switch means having first, equilibrium and third positions comprising: a mounting means; a means mounted on said mounting means, said means including members extending therefrom; an actuator

means having an extremity coupled to said mounting means, said actuator means slidably interfitting with said members and extending therebeyond; a contact carrying blade pivotably coupled to said members; a bias means coupled to said actuator means and to said blade and extending through the plane of said members, said actuator means slidably displaced along said members by a condition thereby causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

3. A snap action switch means having first, equilibrium and third positions comprising: a mounting means; a means mounted on said mounting means, said means including members extending therefrom; recesses formed on said members; an actuator means having an extremity pivotably seated in said mounting means, said actuator including an opening formed therein, said opening slidably interfitting with said members and extending therebeyond; a contact carrying blade positioned within said opening, said blade including extremities pivotably seated in said recesses of said members; a bias means coupled to said actuator means and to said blade and extending through the plane of said members, said actuator means slidably displaced along said members by a condition thereby causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

4. A snap action switch means having first, equilibrium and third positions comprising: a mounting means having a base and a notched wall; a means mounted on said base, said means including spaced apart members extending from said base; recesses formed on said members; an actuator means having an extremity pivotably seated in said notch, said actuator including an opening formed therein, said opening slidably interfitting with said members and extending therebeyond; a contact carrying blade positioned within said opening, said blade including extremities pivotably seated in said recesses of said members; a bias means coupled to said actuator means and said blade and extending through the plane of said members, said actuator means slidably displaced along said members by a condition thereby causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is linearly displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

5. A snap action switch means having first, equilibrium and third positions comprising: a mounting means having a base and a notched wall; a means mounted on said base, said means including spaced apart members extending from said base; recesses formed on inner faces of said members; an actuator means having an extremity pivotably seated in said notch, said actuator including an opening formed therein, said opening slidably interfitting with corresponding outer faces of said members and extending therebeyond; a contact carrying blade positioned within said opening, said blade including extremities pivotably seated in said recesses of said members; a bias means coupled to said actuator means and said blade and extending through the plane of said members, said actuator means slidably displaced along said outer corresponding faces

of said members by a condition thereby causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is linearly displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

6. A snap action switch means having first, equilibrium and third positions comprising: a mounting means having a base and a notched wall; a means mounted on said base, said means including spaced apart members extending at right angles with respect to said base; recesses formed on inner faces of said members in substantially the same horizontal plane; an actuator means having an extremity pivotably seated in said notch, said actuator including an opening formed in the longitudinal axis thereof, said opening slidably interfitting with corresponding outer faces of said members and extending therebeyond; a contact carrying blade positioned within said opening, said blade including extremities pivotably seated in said recesses of said members; a bias means coupled to said actuator means and said blade and extending through the plane of said members, said actuator means slidably displaced along said outer corresponding faces of said members by a condition thereby causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is linearly displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

7. A snap action switch means having first, equilibrium and third positions comprising: a mounting means having a base and a notched wall; a means mounted on said base, said means including spaced apart members extending at right angles with respect to said base; recesses formed on

inner faces of said members in substantially the same horizontal plane; an actuator means having an extremity pivotably seated in said notch, said actuator including an opening formed in the longitudinal axis thereof, said opening slidably interfitting with corresponding outer faces of said members and extending therebeyond; a contact carrying blade positioned within said opening, said blade including notched extremities pivotably seated on said recesses of said members; a spring bias means coupled between said actuator means and said blade and extending through the plane of said members, said actuator means slidably displaced along said outer corresponding faces of said members by a plunger means engaging with and displacing the other extremity of said actuator causing pivotable displacement of said blade through said bias means with a snap action motion until the plane of said blade and the plane of said actuator substantially coincide thereby causing said blade to maintain an equilibrium position, thereafter said blade is linearly displaced with said actuator until a predetermined displacement is attained by said actuator, thereafter said blade is snapped into said third position.

References Cited by the Examiner

UNITED STATES PATENTS

2,508,040	5/1950	Ransome	200—67
2,905,780	9/1959	Cherry	200—67
3,073,923	1/1963	Anderson et al.	200—67
3,132,528	5/1964	Elle et al.	74—125
3,144,779	8/1964	Linn	74—125
3,188,408	6/1965	Farmer	200—38
3,204,052	8/1965	Wiser et al.	200—38

OTHER REFERENCES

Jakel Gustav, German application, 1,018,957, November 7, 1957.

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