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W. J. SCHULTZ ET AL

2,900,463

TIME SWITCH ASSEMBLY

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2 Sheets-Sheet 1

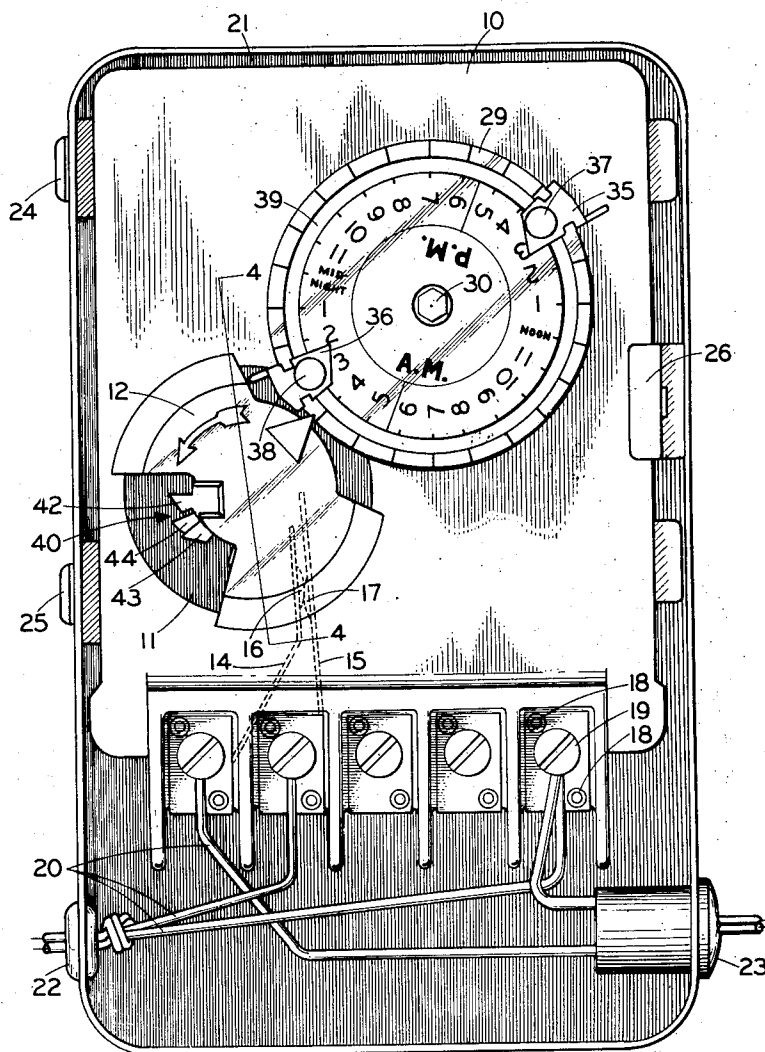


Fig. 1

Inventors :
William J. Schultz
Carl F. Van Bennekom
by *Richard C. Hosley*
Their Attorney

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2 Sheets-Sheet 2

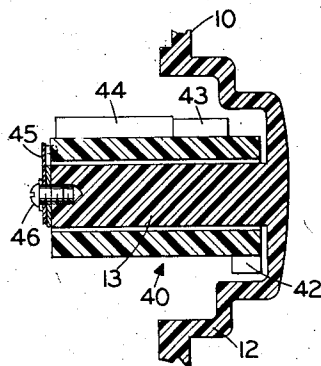


Fig. 4

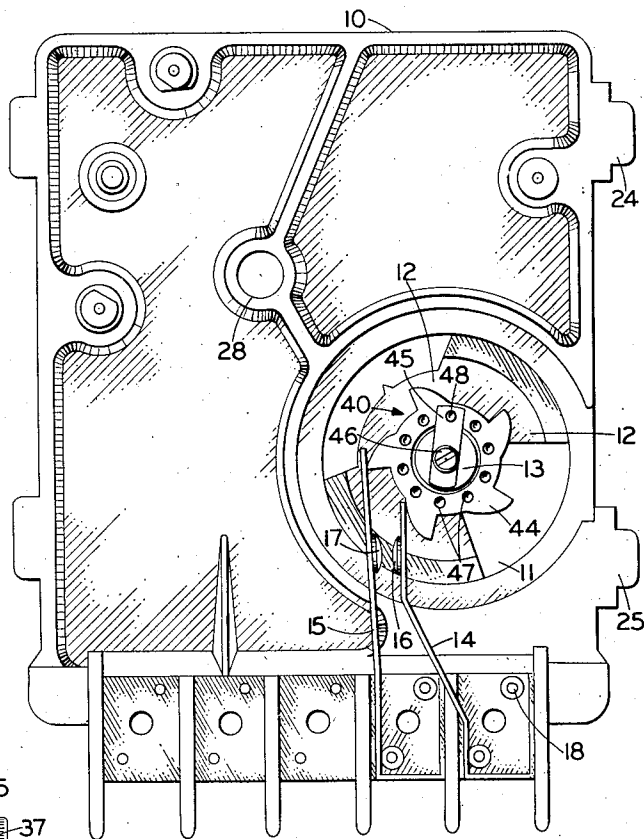


Fig. 3

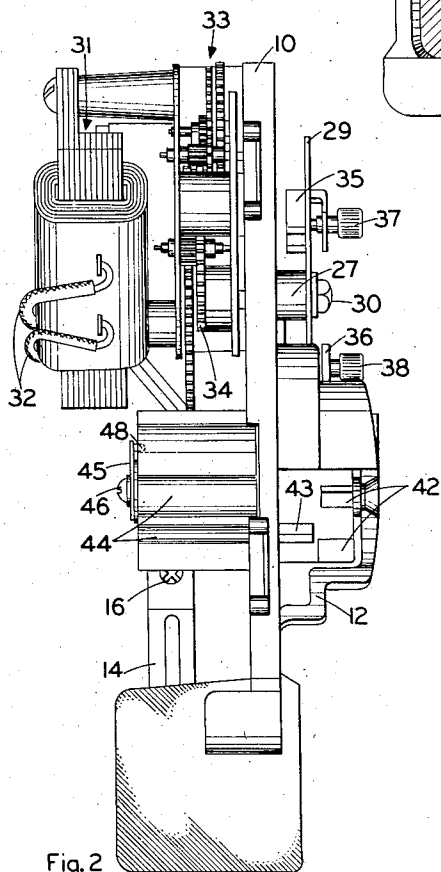


Fig. 2

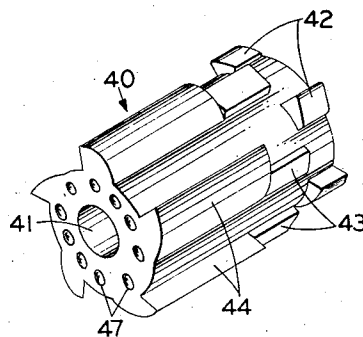


Fig. 5

Inventors :
William J. Schultz
Carl F. VanBennekom
by *Richard E. Holey*
Their Attorney

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2,900,463

TIME SWITCH ASSEMBLY

William J. Schultz and Carl F. van Bennekom, Lynnfield, Mass., assignors to General Electric Company, a corporation of New York

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10 Claims. (Cl. 200—38)

This invention pertains to time switches and more particularly to an improved assembly for a time switch that can automatically and regularly control electric circuits on a schedule related to the time of day.

Such time switches normally include a pair of contact spring blades operable to open and closed switching positions by a switch operator mechanism adapted to be operated at preselected times according to a schedule of operations by a plurality of actuators movable in sequence into operative engagement with the switch operator mechanism. The schedule of switch operations is established by arranging actuators on a rotatable calibrated dial member which is operated in a timed manner by a suitable driving mechanism such as a synchronous motor and reduction gear.

In assemblies of such time switches, it has been customary to mount the operating elements on a support plate which in turn may be mounted in a box-type housing for installation at a control station where it is in easy access for manual settings and maintenance. For purposes of convenience and safety, the calibrated dial member and switch elements are generally mounted on opposite sides of the mounting boards, the calibrator dial being on the front side where it is easily accessible for adjustment and reading of the settings of the actuators. For purposes of accuracy and reliability, the switch elements are operated in a snap acting manner. Heretofore, switch operating mechanisms which could effectuate an operative connection between the switch blades and the actuators on the calibrated dial to produce switch operations in a snap acting manner have been unduly complicated and have often been made from a multiplicity of operating parts. A consequence of the complicated nature of such switch operating mechanisms has been to impose a relatively high torque load on the drive mechanism when the actuator element carried by the calibrated dial is brought into engagement with the switch operator to effectuate switching. On the other hand, during intervals between such switch operations, as established by a predetermined schedule, a relatively low torque is required since the calibrated dial member and the actuators represent the only load on the drive mechanism. Thus, an appropriately sized drive mechanism for meeting the high torque demand often exceeded the low torque demand by a considerable degree. Such a disparity presented undesirable costliness of manufacture since it required large size operating elements. A further consequence of a complicated switch operating mechanism has been the introduction into quantity production of such switches, under normal methods of manufacture and assembly, considerable opportunities for misalignments and concomitant inaccurate operation as well as possible malfunctioning. Significant solutions to these problems have heretofore involved increased cost and reduced likelihood of the realization of successful quantity production at reasonable costs.

It is therefore an object of this invention to provide a new and improved time switch having a new and im-

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proved assembly particularly suitable for low cost quantity manufacture and having a reduced number of parts resulting in increased reliability, simplicity, and efficiency of operation.

5 It is also an object of this invention to provide a new and improved time switch assembly having reduced disparity in loading of the drive mechanism in operation of the switch.

10 In accordance with this invention, a time switch assembly is provided in which a unitary switch operator is designed to be directly engageable with both the spaced actuator elements carried by a rotatable time operated dial upon one side of a support plate and deflectable switch elements on the opposite side thereof. In the preferred embodiment, the switch operator is cylindrical and has cam means integral with and radiating from the peripheral surface thereof. Supporting the switch operator in its operative position so as to make possible the direct engagement of the cam means with the actuator elements and switch elements is a stationary shaft positioned within an enlarged opening in the support plate. The shaft in turn has one end fixedly attached to a bridge member which is preferably concavo-convex in shape and spans the opening on one side of the plate to which it is attached. In the preferred embodiment, the shaft is integral with the bridge member which in turn is integral with the support plate. When given this construction, the shaft, bridge member, and support plate, being integral, form a unitary piece to provide fixed positioning and rigid support. Attached to the free end of the shaft is a means for retaining the unitary operator in operating position. Since, in the preferred embodiment, the switch elements are resilient blades bearing on one side of the operator they exert a counterrotary torque. To oppose counterrotation of the switch operator, the retaining means is designed to bear against the end of the switch operator. To offer increased resistance to counterrotation, the end of the switch operator is provided with circumferentially disposed recesses and the retaining means is made in the form of a resilient blade or plate biased into engagement with the end of the cylindrical operator and having a protrusion therein for riding into and out of the said recesses as the operator is rotated on the shaft.

45 Thus, it can be appreciated that an improved time switch has been provided having a simplified operation mechanism for improving switch operating efficiency. It will also be appreciated that a new and improved time switch assembly has been provided which is particularly suitable for low cost quantity manufacture and has a reduced number of parts resulting in a simplification of the operation of the time switch. A unitary switch operator having integral cam means on the outer surface thereof may be cast or molded thereby permitting accurate and fixed positioning of cam surfaces. The shaft and bridge member being attached to each other and the bridge member being attached to the support plate makes possible a molding or casting of a support member which is completely unitary. Thus, the positioning of the parts to be operative to perform a switching function can be accurately controlled without undue emphasis on close manufacturing tolerances. In addition, a further simplification is achieved by providing a free end shaft support to which may be attached a retaining means which can also function as an antirotation mechanism.

65 The features of this invention which are believed to be novel are set forth in the appended claims while further important aspects and features as well as objects and advantages will be more readily understood by a reference to the following detailed description and drawings in which:

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Figure 1 is a front elevation showing the time switch assembly mounted in position within an enclosing case.

Figure 2 is a left side elevation of the time switch assembly of Figure 1 without the enclosing case.

Figure 3 is a rear elevation of the time switch assembly of Figure 1 without the enclosing case and with certain operating elements eliminated for clarity of description.

Figure 4 is a fragmentary section taken along line 4-4 in Figure 1.

Figure 5 is a perspective view of the unitary switch operator.

Referring to the drawing, there will be seen particularly in Figures 1, 2, and 3, a time switch assembly incorporating the features of this invention which in a preferred embodiment comprises a support plate 10 having an enlarged opening 11 permitting through access to the front and rear sides of the plate. Spanning the opening 11 on the front side of plate 10 is a bridge member 12 preferably integral with the plate. Extending rearwardly through opening 11 and substantially centrally disposed therewithin is stationary shaft support 13 which in cantilever fashion has one end fixed to bridge member 12 while the opposite end is freely extended beyond the rear side of plate member 10 (see particularly Figure 4).

Mounted on support member or plate 10 and extending along the rear surface thereof is a switch in the form of a pair of parallel deflectable resilient blade members 14 and 15, having suitable contacts 16 and 17 thereon. While any satisfactory technique or arrangement for fastening blades 14 and 15 to support plate 10 may be practiced, it is preferred that plate 10 be provided with an integral terminal board on the bottom edge thereof and that this support be shaped to provide recesses in which blades 14 and 15 are individually anchored at corresponding ends. In accordance with the preferred practice, blades 14 and 15 are fabricated from suitable resilient material to have integral flanged portions on their ends designed to wrap around the end of and engage opposite sides of the terminal board and to be anchored thereto by eyelet rivets 18 which transfix the flanged portions of the blade members in place in a manner more fully described in the copending application of Warren N. Kernander and Carl F. Van Bennekom, filed July 19, 1956, having Serial No. 508,951, and assigned to the same assignee as the present application. Terminal screws 19 are provided for attaching electrical conductors 20 directly to blades 14 and 15 thereby connecting the switch into the electric circuit to be controlled. Case 21 may be provided with suitable insulating bushings 22 and 23 inserted in openings in case 21 to provide passage of conductors 20 through the casing into the area of the terminal boards. Plate member 10 may be also provided with hinge abutments 24 and 25 along an edge thereof which are removably fitted to form a hinge connection with the side of case 20. On the opposite side of case 21, a latch member 26 is attached thereto to engage the edge of support member 10 proximate to that edge of case 21.

Substantially parallel with stationary shaft 13 is rotatable shaft 27 mounted within appropriate bearing means 28 (see Figure 3) in support plate 10. On the front side of support plate 10 calibrated dial 29 is attached by suitable screw means 30 to one end of rotatable shaft 27 so as to be rotatable therewith. Timed operation of the calibrated dial 29 is obtained through the operation of a suitable constant speed electric drive including a synchronous electric motor 31 having suitable conductor leads 32 for connection to a power supply (not shown) and reduction gearing 33 including a driven gear 34 fixedly attached to the opposite end of rotatable shaft 27 (see Figure 2). Attached to the calibrated dial 29 in selectable position on the front face thereof are actuator elements 35 and 36 generally shaped to extend ra-

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dially beyond the end of dial 29 so as to enter into the realm defined by the concavity of bridge member 12. In addition, actuator elements 35 and 36 are designed to have their extensions displaced axially in planes parallel to each other. In accordance with well-known switch operations, actuator element 35 may be designated an "on" actuator while actuator 36 may be designated an "off" actuator. The time of day when such operations occur, of course, is determinable by setting of actuator elements 35 and 36 at calibrated positions on the face of dial 29. For adjustable attachment of the actuator elements to dial 29 actuator elements 35 and 36 are designed to span the dial 29 and to have setscrews 37 and 38, respectively, grip the dial. In a preferred manner, dial 29 may be provided with a groove 39 in the face thereof for receiving the end of setscrews 37 and 38 thereby enhancing the gripping action to more firmly fix the actuators in their set positions.

Direct operative connection between actuator elements 35 and 36 and switch blades 14 and 15 is obtained through a unitary switch operator 40 which in its preferred embodiment is cylindrical in shape and has an axial opening 41 therethrough for mounting on stationary shaft support 13. The outer peripheral surface of operator 40 is provided with sets of longitudinally disposed actuator cams 42 and 43 and operator cams 44. For periodically and alternately engaging actuator elements 35 and 36 as they are carried by rotatable dial 29 actuator cams 42 and 43 are arranged in parallel planes transverse to the operator 40 and the individual cams of the respective actuator cam sets are angularly offset from each other. Longitudinally displaced from actuator cams 42 and 43 are operator cams 44 formed on the outer peripheral surface of operator 40 and circumferentially spaced and contoured to effectuate relative deflections of switch blades 14 and 15 to obtain snap action switching.

In its operative position, switch operator 40 is rotatably mounted on stationary shaft support 13 so as to be within opening 11 of support plate 10. Actuator cams 42 and 43 are thereby within the concavity afforded by bridge member 12 and are consequently positioned in line with actuator elements 35 and 36 to be periodically engaged thereby. Operator cams 44 are designed to extend longitudinally to a degree such that operative engagement is made with switch blades 14 and 15. Maintaining switch operator 40 in operative position on shaft support 13 is a retaining means preferably formed of a resilient blade 45, one end of which is attached to the free end of stationary shaft support 13 by a suitable screw 46 removably turned into a threaded opening in the end of shaft support 13. Resilient blade 45 is so designed as to bear against the end of operator 40 in the annular region between opening 41 and the base of cams 44. Resistance to counterrotation caused by counter-rotary torque applied to operator 40 through the bias force exerted by switch blades 14 and 15 is thereby achieved. Further increase of this resistance to counterrotation is obtained by forming a plurality of circumferentially disposed recesses 47 in the end of operator 40 and providing a protrusion 48 on the end of resilient blade 45.

Prior to initiation of operation, "on" and "off" actuator elements 35 and 36 are adjustably set to suitable positions on dial member 29 and switch operator 40 is rotated manually to bring the proper actuator cam into position to meet the actuator cam designed to engage it. Upon energization of motor 31, such as by closing a manually operated switch in the circuit of the motor leads 32, motor 31 begins rotating at a fixed rate of speed. Gear train 33 and particularly gear 34 are then driven at the constant rate, the speed of the motor being reduced by suitable selection of the individual gears in train 33 to produce one complete revolution for every twenty hours for gear 34 and, hence, dial member 29. In its rotation on shaft 27, dial member 29 carries actuator members 35 and 36 in circular paths until they al-

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ternately are brought into the realm of bridge member 12 to engage the actuator cams 35 and 36. Assuming actuator 35 is an "on" actuator and actuator 36 is an "off" actuator and actuator cams 42 and 43 are "on" and "off" cams, respectively, actuator 35 having passed through the realm of bridge member 12 as shown in Figure 1 will have engaged one of the actuator cams 42 causing it to rotate a fraction of a complete turn. Operator cams 44 and actuator cams 42, being integral parts of the operator 40, will be rotated equivalent angular amounts. Operator cams 44, due to their circumferential disposition along the peripheral surface of operator 40 and their contouring, will have moved an amount to permit blade 15 to drop off a leading cam surface to bring contact 17 into engagement with contact 16 of blade 14, blade 14 being moved forward by the rotation of operator 40 by a trailing cam 44. Due to the resilient nature of the blade, the drop off produces snap action in switching. At the same time that operator cams 44 are deflecting blades 14 and 15 to a switching position, actuator cam 43, by proper angular displacement from actuator cams 42, will be moved angularly into position to meet the radial extension of "off" actuator 36.

Continued rotation of dial member 29 brings "off" actuator 36 along its circular path and into the realm of the bridge member 12. Because "off" actuator 36 extends axially farther than actuator 35, it will move in a plane coincident with the plane of actuator cams 43. Thus, "off" actuator 46 engages an "off" actuator cam 43 to rotate operator 40 a fraction of a complete turn. Consequently, operator cams 44 are also rotated to a degree such that blade 14 drops off the edge of the cam surface. In doing so, blade 14 moves to a position tending to separate the contact 16 from contact 17, thereby opening the switch. Because of the deflection against the resilient bias of both blades when in the switch closed position, blade 15 tends to follow blade 14. However, because of the unequal lengths of the switch blades, the spacing of the operator cams, blade 15 is prevented from following blade 14 to its complete deflection. Thus, blade 15 comes into engagement with a leading operator cam 44 while blade 14 drops off to engage a trailing operator cam. To achieve the accuracy of operation desired in such switch action, the angular and circumferential spacing of the cam surfaces, as well as suitable contours thereof, must be controlled within a reasonable tolerance. It has been found that this can be very easily achieved through the unitary construction of the operator. Furthermore, the unitary construction assures fixed relative position of the cams thereby improving reliability in usage.

It will be noted that, during the operation of the switch blades, they continue to exert a torque in opposition to the turning torque supplied from the actuator elements 35 and 36 to actuator cams 42 and 43. This counter-torque, while appreciable to cause reverse rotation of operator 40, is considerably less than that required of prior devices using more complicated structures. Therefore, motor 31 and its connected gearing can be designed from reduced capacity criteria to realize a saving in space and other manufacturing costs.

If the counterrotary torque were allowed to act, switch operator 40 would be reversed some angular distance from that to which it was advanced through action of the actuator elements on the actuator cams. This condition, if allowed to exist, would affect the accuracy of alignment of the cams and would further affect certainty of switch operation. To overcome these undesirable effects, spring member 45 which functions to retain operator 40 on shaft 13 does so by bearing against the end of operator 40 and imposing a resistance to rotation thereof. Counterrotation is assured within reasonable limits permitting easy rotation of operator 40 by the drive mechanism when protrusion 48 on spring member 45 rides into circumferentially arranged recesses 47 as

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operator 40 is rotated in its successive angular advances during switching. Because of the arrangement of the parts to provide a free end shaft support, easy access to the spring member 45 for adjustment of spring tension and positioning is provided. Thus, the effectiveness with which anticounterrotation is achieved is controllable within limits consistent with resistance to rotation from the drive mechanism.

Therefore, while a particular embodiment of the subject invention has been shown and described herein, it is in the nature of description rather than limitation, and it will occur to those skilled in the art that various changes, modifications, and combinations may be made within the province of the appended claims, and without departing either in spirit or scope from this invention in its broader aspects.

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

1. A time switch assembly comprising in combination a support member having an enlarged opening therethrough, a concavo-convex bridge member across said opening fixed to said support member, a stationary shaft carried by said bridge member so as to extend through said opening and beyond the rear face of said support member, relatively movable switching elements mounted to the rear of said support member, an actuating device including a timed rotary member mounted to the front of said support member and spaced actuator elements carried thereby, a cylindrical operator having longitudinally arranged sets of arms radiating from the peripheral surface thereof, said operator being rotatably mounted on said shaft and rotated by said actuating device within said opening and the concavity of said bridge member whereby a first set of said cam means protrudes from said opening in said support member to be periodically engageable with said actuator means and a second set of said cam means is in operative relation with said switch means.

2. A time switch assembly comprising in combination a support member having an enlarged opening therethrough, a cup-shaped member integral with said support member to cover said opening on the front side thereof, said cup-shaped member having an opening in the side thereof providing access to the inner realm thereof, a shaft member integral with said cup-shaped member and extending from the inner surface thereof through said enlarged opening, relatively movable switching blades mounted to the rear of said support member, a timing device including a rotatable calibrated timing disc mounted to the front of said support member having its peripheral edge proximate said opening in said cup-shaped member, actuator elements carried by said disc and moving therewith to describe an arc through said opening in said cup-shaped member, a cylindrical operator having actuator cams and operating cams disposed axially along the peripheral surface of said operator, said operator being rotatably mounted on said shaft and positioned to have said actuator cams within the inner realm of said cup-shaped member so as to radiate outwardly through said opening in the side thereof for engagement with and rotation by said moving actuator elements, said operator cams being in operative relation with said blades, and means attached to the free end of said shaft for holding said operator in operating position.

3. A time switch assembly comprising in combination a support plate member having an enlarged opening therethrough, a cup-shaped member integral with said support plate member to cover said opening on the front side thereof, said cup-shaped member having an opening in the side thereof providing access to the inner realm thereof, a shaft member integral with said cup-shaped member and extending from the inner surface thereof through said enlarged opening beyond the rear face of said support member, relatively movable switching blades mounted to the rear of said support member, a timing de-

vice including a rotatable calibrated timing disc mounted to the front of said support member having its peripheral edge proximate said opening in said cup-shaped member, actuator elements carried by and extending beyond the edge of said disc and moving therewith to describe an arc through said opening in said cup-shaped member, a cylindrical switch operator having actuator cams and operator cams disposed axially along and integral with the peripheral surface of said operator so as to radiate therefrom, said operator being rotatably mounted on said shaft and positioned to have said actuator cams within the inner realm of said cup-shaped member so as to radiate outwardly through said opening in the side thereof for engagement with and rotation by said moving actuators, said operator cams being in operatively wiping engagement with said deflectable blades, and means attached to the free end of said shaft for holding said operator in operating position.

4. A time switch assembly comprising in combination a support member having an enlarged opening there-through and a bridge member on one side thereof spanning said opening, a stationary shaft centrally disposed within said opening having one end connected to said bridge member and the other end freely extended beyond the opposite side of said support member, a timing device including a rotatable disc on one side of said support member and actuator elements carried thereby, deflectable switch elements on said support member on the side opposite said rotatable disc, a unitary switch operator rotatably mounted on said shaft, said operator having cam means for operatively engaging said actuator elements and said switch blades, said operator being rotated by means of said actuator elements, and means attached to the free end of said shaft for retaining said operator in operative position.

5. A time switch assembly as in claim 4 in which said support member including said bridge member and said stationary shaft are formed as a unitary piece.

6. A time switch assembly as in claim 4 in which said cam means is formed integral with said cylindrical operator.

7. A time switch assembly as in claim 4 in which said support member including said bridge member and said shaft are made as a unitary piece and said cylindrical

operator has said cam means formed integral with the outer surface thereof.

8. A time switch assembly as in claim 4 in which said retaining means is an anticounterrotation element.

9. A time switch assembly as in claim 4 in which said cylindrical operator has circumferentially disposed recesses on the end thereof and said retaining means comprises a resilient member biased into engagement with the end of said cylindrical operator, said resilient member having a protrusion for riding into and out of said recesses as said operator is rotated on said shaft.

10. A time switch assembly comprising in combination a support member having an enlarged opening there-through and a bridge member on one side thereof spanning said opening, a stationary shaft centrally disposed in said opening having one end fixed to said bridge member and the other end freely extending beyond the opposite side of said support member, a unitary switch operator rotatably supported by said shaft, said operator having integral cam means on the outer peripheral surface thereof, a timing device including a rotatable disc on one side of said support member and a plurality of actuator elements carried thereby for periodically engaging certain of said cams to impart rotation to said operator, resilient switch elements on said support member on the side opposite said rotatable disc, said switch elements being in biased engagement with certain other of said cam means, said switch elements imposing a net bias torque on said operator, and resilient means attached to the free end of said shaft biased into engagement with the end of said operator to resist counter-rotation due to said bias torque.

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