Feb. 19, 1957 H. A. POWERS ET AL 2,782,274

LOW COST CLOCK SWITCH

Filed June 19, 1953

Fig. 2.

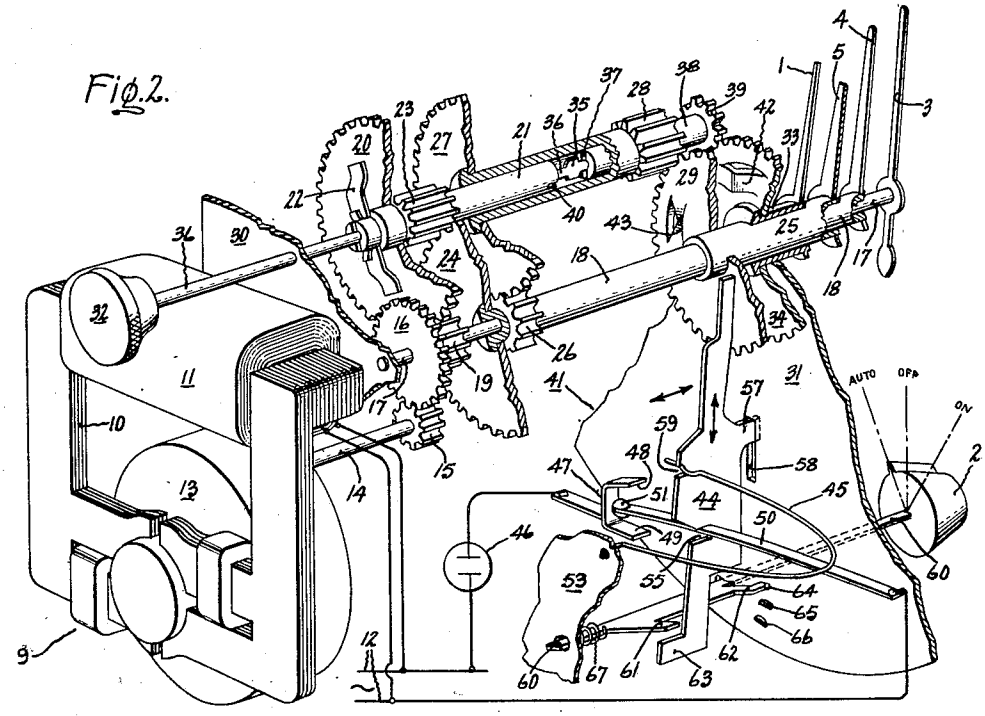


Fig. 3.

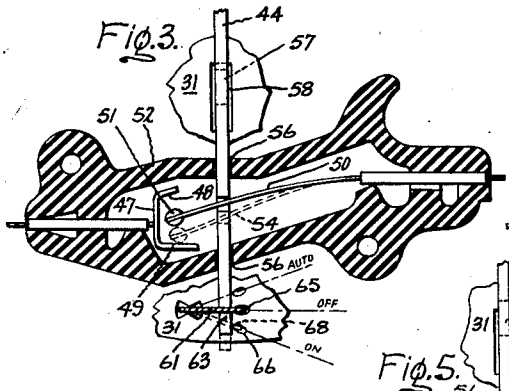


Fig. 4.

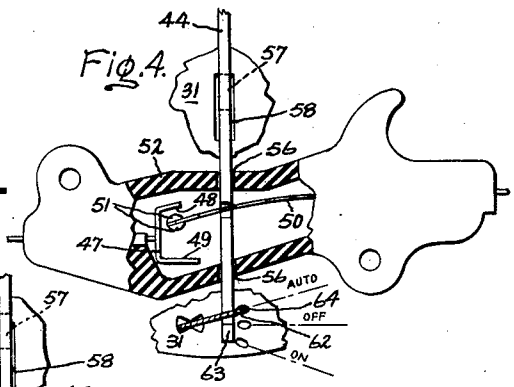


Fig. 5.

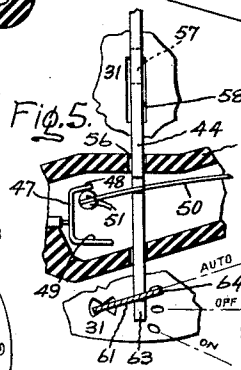
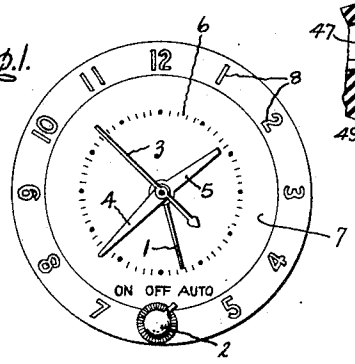


Fig. 1.



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LOW COST CLOCK SWITCH

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11 Claims. (Cl. 200—38)

The present invention relates to time-controlled switches and, more particularly, to adjustable automatic electrical switching apparatus actuated by electric clock mechanisms.

As is well known in the timed switching art, combinations of electrical switches and synchronous electrical clockworks afford inexpensive and highly precise controls for household appliances and other electrical apparatus. Conventionally, the electrical clock itself functions to present a visual display of the time, and the time-controlled electrical switches which are integrated with this clockwork to produce an automatic timer may further require the use of a considerable number of gears, cams and knobs which make the unit complex, expensive to manufacture, and somewhat complicated for the user to set. In accordance with the present teachings, such clock timers are improved such that only two simple knobs are required to accomplish the full complement of standard adjustments for the clock and a single-circuit manual and automatic switch, and such that fewer and less expensive components are employed. These important advantages are largely occassioned by a unique and superior electrical switching arrangement which cooperates with the clockwork and is also responsive to the setting knob adjustments.

It is therefore one object of this invention to provide a novel and improved clock-actuated electrical switching apparatus which is of reduced complexity and is simply and conveniently adjusted.

Additionally, it is an object to provide a novel electrical clock and timer unit having an improved clock-actuated switch and switch control mechanisms.

By way of a summary account of one aspect of this invention, there is provided an electric clock movement wherein a synchronous electric motor rotates both hour and minute pointers about a common axis through reduction gearing, a knob being provided for manual actuation of these pointers when in one axial position and for manual actuation of a time-setting pointer when in a second axial position. This knob performs both actuations through structure which is partly in common with the reduction gearing structure. Cam projections which are punched in two adjacent gears, one connected with the setting pointer and the other with the hour pointer, engage at the proper moment to displace the hour pointer gear in an axial direction, which its mounting permits. This simple timed axial movement of the hour pointer gear is the principal control for any automatic electrical switching which the unit may be set to perform, such as the switching of a radio circuit. In cooperation with the mechanism for producing the axial movement of this gear, there is included a three-position switch having an elongated switch actuator arm which is movable longitudinally between two positions, an "on" and "off" position, when the arm has one lateral orientation, and which is resiliently urged to a third position, an "automatic on" position, when the arm has a second lateral orientation. The elongated actuator arm is normally spring-biased into the first lateral

position where it bears against the hour pointer gear, but is moved to the second lateral position when that gear is automatically moved in an axial direction by the engagement of the aforementioned cam surfaces at the pre-set time. Adjustment of the switch arm to any one of the three named positions is accomplished by simple rotation of a knob on the face of the instrument.

Although the features of this invention which are believed to be novel are set forth in the appended claims, greater detail of the invention itself and the further objects and advantages thereof may be readily comprehended by reference to the following description taken in connection with the accompanying drawing, wherein:

Figure 1 is a pictorial representation of the dial, pointers and one of the two setting knobs for a clock and switch unit embodying the teachings of this invention;

Figure 2 represents a perspective view of a preferred clock-switch mechanism;

Figure 3 is a partly sectioned side view of the switch mechanism, set in the "off" position;

Figure 4 illustrates a cut-away switch mechanism set in the automatic control position, and

Figure 5 depicts a partly sectioned view of a portion of the switch mechanism which has closed its contacts in the automatic control position.

As is evident from the portrayal of a clock and switch unit in Figure 1, the unit may have the general external appearance of a clock alone, except for the provision of a time-setting pointer 1 and the rotatable switch control knob 2 with its three cooperating position references labelled "On," "Off," and "Auto" (automatic), from left to right. The customary array of clock dial and pointer components is present, including a sweep second hand 3, minute hand 4, hour hand 5, minute divisions 6 on a dial 7, and reference characters 8. In a manner appearing more fully hereinafter, the time-setting pointer 1 may be adjusted to a desired time, and, with the knob 2 turned to the right "auto" position, an electrical circuit will be closed automatically upon the clock's having registered the pre-set time represented by the pointer 1.

Figure 2 represents the essential mechanisms to the rear of a timer face such as that shown in Figure 1, and corresponding parts are designated by the same reference characters. The clock motor 9 is illustrated as a self-synchronous type of electric motor having a stator core 10 and excitation winding 11, the latter being energized from an alternating current source represented by supply leads 12. Casing 13 contains the usual rotor and suitable gearing through which the terminal shaft 14 and the drive gear 15 are rotated at a uniform speed which is a fixed submultiple of the supply frequency. In turn, the main gear 16 is rotated, by drive gear 15, at a speed of one revolution per minute, carrying with it the attached shaft 17 and the second hand 3 affixed to the end of this shaft.

By transmitting the synchronized movements of second hand shaft 17 through speed reduction gearing, the minute hand 4 and its attached drive shaft 18, concentric with the second hand shaft 17, are caused to revolve at the speed of one revolution per hour. This power flow may be traced from the gear 19, attached to the second hand shaft 17, to the intermediate gear 20, which is mounted on shaft 21 for relative angular movement, to shaft 21 through the spring clutching element 22 connected to shaft 21 and bearing against gear 20, to drive gear 23 attached to shaft 21, and to the gear 24 which is fastened to and rotates the minute hand shaft at the synchronized speed of one revolution per hour.

Also, by transmitting the synchronized movements of the minute hand shaft 18 through speed reduction gearing, the hour hand 5 and its attached drive shaft 25, concentric with both the second hand shaft 17 and minute hand shaft 18, are caused to revolve at the speed of two revolutions

per day. This power flow may be traced from the gear 26, attached to the minute hand shaft 18, to the intermediate gear 27, which is mounted on shaft 21 for relative angular movement, to elongated drive gear 28 which is rotatable with gear 27, and thence to the gear 29 which is fastened to and rotates the hour-hand shaft 25 at the synchronized rate of two revolutions per day.

For switching purposes explained hereinafter the hour hand gear 29, its attached shaft 25, and the hour hand 5 are movable axially, as a unit, along the outer surface of the minute hand shaft 18. Because of its elongation, drive gear 28 remains in mesh with minute hand gear 29 over the permissible range of axial travel of the latter gear. Fixed support plates 30 and 31 provide mountings for the various gear and shaft components mentioned.

A third motion flow path may be traced from the rear knob 32 to the time-setting pointer 1. Rotation of pointer 1 and its shaft 33 and attached gear 34 is accomplished by pressing the knob 32 forward, such that the key portion 35 on the knob shaft 36 engages the slot 37 in shaft 38 affixed to the drive gear 39, and by rotating the knob. Since drive gear 39 is positioned for meshing with the time-setting pointer gear 34, rotation of knob 32 results in rotation of its shaft 36, key portion 35, shaft 38, drive gear 39, time-setting gear 34, time-setting pointer shaft 33, and the time-setting pointer 1. When keyed portion 35 is out of engagement with the key slot 37, the flow path is severed and friction effects lock the time-setting gear and pointer in the adjusted position.

A further motion flow path is traced from rear knob 32 to the minute and hour hands 4 and 5, such that these pointers may be set to register the proper time. For this purpose, knob 32 is pulled rearwardly until the keyed portion 35 of its shaft 36 mates with the concentric shaft 21 in the key slot 40. Knob 32 is then rotated, whereupon the following members are also caused to rotate: knob shaft 36, keyed portion 35, shaft 21, drive gear 23, minute hand gear 24, minute hand shaft 18, and minute hand 4. Because the drive gear 26 is attached to the minute hand shaft 18, it too rotates and simultaneously actuates the hour hand 5, in the manner previously discussed, to preserve appropriate relative orientations of the minute and hour hands. At such times as the knob is manipulated to position these hands, the shaft 21 and drive gear 23 are caused to rotate; however, the intermediate gear 20 which normally actuates these hands does not rotate with shaft 21 but slips against the torques imposed by the spring clutching member 22 and is oriented solely by the meshing second hand gear 19. When the torques manually exerted upon shaft 21 through rear knob 32 are less than those which are exerted by the train of gears 15, 16, 19 and 20 and by clutching member 22, as when the knob is released, the minute and second hands are driven by the motor 9.

Actuation of the electrical switching unit 41, which is a part of the timer, is initiated by double-sloped cam projections 42 and 43 extending from adjacent sides of the time-setting gear 34 and hour hand gear 29. Switch actuator arm 44 bearing against gear 29 under the influence of a spring 45, urges gear 29 axially toward the time-setting gear 34, such axial freedom of movement of gear 29 and its shaft 25 and hour hand 5 being permitted by the loose sleeve mounting of shaft 25 on the minute hand shaft 18. The instantaneous angular orientation of cam projection 43 on hour hand gear 29 depends upon the precise time which its attached hour hand 5 then indicates. And, the angular orientation of cam projection 42 on time-setting gear 34 depends upon the precise time at which the time-setting pointer 1 is pre-set. These two cam gears and their attached pointers are initially arranged such that their cam projections 42 and 43 will be in exact alignment when the time-setting pointer and hour hand register the same time as read against the indicia on the clock dial. Prior to engagement of the cam surfaces, the gears 29 and 34 are closely spaced. When the cam projections are in alignment, however, this spacing is increased and results in a rearward axial displacement of gear 29 (and its shaft 25 and hour hand 5) against the force of spring 45 transmitted to gear 29 by switch actuator arm 44. It is this timed axial movement of hour hand gear 29, and the consequent lateral movement of switch actuator arm 44, which controls the automatic electrical switching in the timer.

Switch 41 is illustrated in a series circuit relationship with an outlet 46 across the A. C. supply lines 12, the outlet 46 representing any apparatus or circuitry which may be associated with the timed switching unit, such as a radio. The electrical contact components of the switch include a stationary U-shaped contact tip member 47 suitably mounted in a fixed position, and having upper and lower contact legs 48 and 49, and a flexible contact spring blade 50 with contact points 51 at one end, in position to engage one or the other of contact legs 48 and 49, and with a suitable fixed support at the other end. Support for these contact elements may be provided by a plastic enclosure and support, such as the enclosure 52 shown in Figure 3, which is in turn fixedly mounted between front and intermediate mounting plates 31 and 53. Contact spring 50 may be flexed vertically to move the contact points between three useful positions, the lowermost or "on" position, at which electrical contact is established between the lower contact leg 49 and points 51, an uppermost or "auto" (automatic) position, at which electrical contact is established between the upper contact leg 48 and points 51, and an intermediate or "off" position, at which the points 51 are out of electrical contact with the contact legs. The last-mentioned "off" position is shown in Figures 2, 3 and 4, the lower "on" position is illustrated by the dashed lines 54 in Figure 3, and the "auto" on position is pictured in Figure 5.

Switch actuator arm 44, which is preferably constructed of insulating material, is provided with a slot 55 in which the flexible switch blade is positioned such that its vertical movements will urge the switch contacts into and out of engagement. Arm 44 is movable in relation to the switch casing 52 through appropriate vertical guide slots 56 (Figures 3 and 4). A projection 57 from actuator arm 44 extends in a forward direction and is spring-biased into a vertical slot 58 in the front mounting plate 31 whenever the hour hand gear 29 is not pushed to its rearmost position by cam projections 42 and 43. This projection and slot are arranged to limit the vertical travel of actuator arm 44 and thus prevent engagement between switch contacts 51 and 48 as long as the arm 44 is not tilted back by gear 29 to the point where projection 57 leaves slot 58 and is pushed further upward by spring 45. The latter event occurs when the clock registers the pre-set time, and thereupon the arm 44 urges one of contact points 51 into engagement with the contact leg 48 to complete the electrical circuit through apparatus connected with outlet 46. In this arrangement, spring 45 serves dual purposes; first, to press arm 44 forward, such that it will bias gear 29 to a forward position also, and, second, to urge arm 44 upward when its projection 57 leaves mounting plate slot 58. To permit this dual action, hairpin spring 45 has one end vertically and laterally restrained in mounting plate 53 and the other end seated in a notch 59 in actuator arm 44. For the position shown in Figure 1, this spring is under compression and, by virtue of its tilted relationship with arm 44, resiliently biases arm 44 in the two directions.

Front knob 2 accomplishes control of the switch operations through the switch set shaft 60, this shaft being formed of plate stock punched to have two projections, 61 and 62, which extend in radial directions from the shaft axis. Limited angular movement of this switch shaft is afforded by openings in the mounting plates 31 and 53 in which the shaft is supported. Projection 61 extends outwardly over a catch projection 63 which is part of actuator arm 44; and projection 62 serves as a

dog in cooperation with the three detents or depressions 64, 65 and 66 punched in the rear of front mounting plate 31. Set shaft spring 67 forces the dog 62 forward such that it will tend to seat in any of the depressions and thus hold set shaft projection 61 in any one of three angular positions corresponding to the "on," "off," and "auto" positions of knob 2.

Figure 3 illustrates the electrical switch apparatus as it is set in the middle or "off" position by front knob 2, that is, with the switch set shaft projection 62 seated in detent 65. In this setting the switch set shaft projection 61 restrains actuator arm projection 63 from moving upwardly beyond a predetermined point, and, when the arm 44 is so positioned, it holds flexible switch blade 50 out of contact with the stationary contact tip 47 and prevents connection of an electrical circuit through the switch. The "off" condition of the switch is preserved despite any other influences to which the arm 44 may be subjected by automatic axial movements of the hour hand gear 29.

The dashed lines 54 and 68 in Figure 3 further show the orientation of the switch blade 50 and switch set shaft projection 61 when the knob 2 is set to the "on" position, that is, when set shaft projection 62 is seated in the lowermost detent, 66. At such times, projection 61 forces actuator arm projection 63 to its lowest position, thereby forcing one of the switch blade points 51 to contact the lower leg 49 of the stationary contact 47 and complete the electrical circuit through the switch. This "on" condition is likewise preserved despite occurrence of any automatic axial movements of the hour hand gear 29.

Figure 4 represents the "auto" (automatic) setting of the switch which obtains when knob 2 is rotated such that switch set shaft projection 62 is seated in uppermost detent 64. However, this illustrated condition is also one wherein the actuator arm has not as yet been pushed rearwardly by automatic axial movement of hour hand gear 29. Accordingly, the actuator arm projection 57 is located in slot 58 of front mounting plate 31 and is prevented from moving further upward because of the obstruction offered by the top boundary of the slot. Thus, even though set shaft projection 61 does not limit movement of actuator arm projection 63 in this "auto" setting, the actuator arm 44 is unable to move up far enough to engage the switch blade contact points 51 with the upper leg 48 of stationary contact 47. The switch remains open-circuited at such times.

Switch contacts 48 and 51 will engage to close the electrical circuit through the switch when, with the components cocked in the above-described "auto" relationship, the cam projections 42 and 43 are fully coincident when the pre-set time is reached and cause the hour hand gear to slide axially rearward against the restraint of switch actuator arm 44. Upon this occurrence, the actuator arm is tilted rearwardly by gear 29, which rearward or lateral tilting movement is permitted by the mounting of arm 44. At a predetermined point in this rearward movement, the actuator arm projection 57 suddenly leaves slot 58 and the spring 45 slides arm 44 upward until the set shaft projection 61, locked in position by the seating of projection 62 in detent 64, stops actuator arm projection 63 and precludes further upward movement of arm 44. This condition is viewed in Figure 5, and it should be noted that the upper leg contact 48 and switch blade contacts 51 are electrically connected at such time to complete the switch circuit. The automatic connection occurs rapidly, thereby applying electrical excitation to the radio or other controlled apparatus at precisely the pre-set instant. Once connection is automatically brought about in this manner, the connection is continued until front knob 2 is moved to the "off" position. This is true because actuator arm 44 is biased upward by spring 45, keeping contacts 48 and 51 closed. The later separation of cams 42 and 43 as the hour hand gear revolves with the passage of time has no effect upon the "auto" closed condition of the switch.

It should be apparent from the foregoing that the specific embodiment of this invention disclosed herein is of a descriptive rather than a limiting nature, and that various changes, combinations, substitutions or modifications, may be employed in accordance with these teachings without departing 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. Automatic timed electrical switching apparatus comprising an electric switch, a switch actuator member for opening and closing said switch, manually adjustable means movable between two fixed positions for controlling said actuator member to open and close said switch and movable to a third fixed position for controlling said actuator member to set said switch for closure, electric clock mechanism for moving said actuator member with respect to said manually adjustable means at a pre-set time to close said switch when said manually adjustable means has been used to set said switch for closure, and manually adjustable means for establishing said pre-set time for said clock mechanism.

2. Automatic timed electrical switch apparatus comprising an electric switch, a switch actuator member for opening and closing said switch, manually actuable means for controlling said actuator member to open said switch and to set the switch for automatic closure, and electric clock mechanism for controlling said actuator member at a pre-set time to close said switch when said manually adjustable means has been used to said switch for closure, said clock mechanism comprising a synchronous electric motor, an axially movable cam gear driven by gearing from said motor, said cam gear being disposed to control said actuator member and thereby to close said switch when moved axially to a given position, and relatively stationary cam means disposed to engage automatically with said cam gear once during each revolution of said cam gear to cause said cam gear to move axially to said position.

3. Automatic timed electrical switching apparatus as set forth in claim 2 wherein said relatively stationary cam means comprises a second cam gear coaxial and proximate with said axially movable cam gear, and further comprising, an axially and angularly movable manual setting member, drive gear means for angularly positioning said second cam gear, and means for coupling said manual setting member with said drive gear means when said setting member is in one axial position and with said motor gearing when in a second axial position.

4. Automatic timed electrical switching apparatus as set forth in claim 3 further comprising slip clutching means intermediate said motor and axially movable cam gear enabling setting of said movable cam gear by said manual setting member without stalling said motor.

5. Automatic timed electrical switching apparatus as set forth in claim 3 further comprising a clock hour hand connected to rotate with said axially movable cam gear, said motor driving said movable cam gear at the rate of two revolutions per day, a time-setting pointer connected to revolve with said second cam gear, and a minute hand, said minute hand being driven at one revolution per hour by said gearing intermediate said motor and hour hand.

6. Automatic timed electrical switching apparatus comprising an electric switch, a switch actuator member movable between two positions along each of two different paths, said switch actuator member closing said switch only when moved to one of each of said positions along each of said paths, manually actuable means for controlling the position of said member along one of said paths, and adjustable electric clock mechanism controlling the position of said actutaor member along the

other of said paths in accordance with a pre-set time schedule.

7. Automatic timed electrical switching apparatus comprising an electric switch, a switch actuator member having switch control positions along two different paths of movement, said switch actuator member holding said switch open when in one of two positions along one of said paths and adapting said switch for closing when in the other position along said one path, and said actuator member holding said switch open when in one of two positions along the other of said paths and adapting said switch for closing when in the other position along said other of said paths, whereby said switch is closed when said actuator member is moved to both of said other positions, manually actuable means controlling the position of said actuator member along said one of said paths, and adjustable electric clock mechanism controlling position of said actuator member along said other of said paths to move said member to the other of said positions along the other of said paths at a pre-set time.

8. Automatic timed electrical switching apparatus comprising at least one stationary switch contact, a movable contact flexibly mounted for movement to and from an electrical contacting relationship with said stationary contact, an elongated switch actuator arm coupled with said movable contact and tiltable and slidable to move said movable contact to and from said contacting relationship, resilient biasing means, said means biasing said arm in the sliding direction to establish said contacting relationship, catch means preventing sliding movement of said arm to a position at which said contacting relationship is established, said catch means operating to prevent said arm movement only when said arm is in one of two tilted positions, said biasing means urging said arm toward said one of said two positions, manually actuable means for slidably moving said switch arm to and yieldably retaining said switch arm in a position preventing said contacting relationship, and adjustable electrical clock mechanism for tilting said switch actuator arm to the other of said two tilted positions at a pre-set time, whereby to permit said contacting relationship to be established and maintained whenever said manually actuable means also permits.

9. Automatic timed electrical switching apparatus as set forth in claim 8 wherein said electrical clock mechanism comprises a synchronous electric motor, a cam gear axially movable to tilt said switch actuator arm to said other of two tilted positions, means intermediate said motor and cam gear for rotating said cam gear, and relatively stationary cam means disposed to engage said cam gear once during each revolution of said gear and to cause said cam gear to move axially to tilt said switch actuator arm.

10. Automatic timed electrical switching apparatus as set forth in claim 9 wherein said relatively stationary cam means comprises another cam gear, and drive gearing for angularly setting said other cam gear, and further comprising a manually rotatable and axially movable setting shaft, and means for coupling said setting shaft with said drive gearing when in one axial position and with said intermediate rotating means when in a second axial position, said intermediate rotating means including slip clutching means preventing stalling of said motor when said setting shaft is in said second axial position.

11. Automatic timed electrical switching apparatus as set forth in claim 10 further comprising an hour hand connected with said cam gear, said hand and gear being rotated two revolutions per day, a minute hand rotated by said intermediate rotating means one revolution per hour, and a time-setting hand connected with said other cam gear.

References Cited in the file of this patent

UNITED STATES PATENTS

2,421,986	Bohman	June 10, 1947
2,505,573	Prophet	Apr. 25, 1950
2,587,026	Beiser	Feb. 26, 1952
2,594,103	Ward	Apr. 22, 1952