Feb. 7, 1939. D. G. CAMERON ET AL. 2,146,562

TIME SWITCH

Filed Sept. 18, 1935 3 Sheets-Sheet 1

Fig. 1.

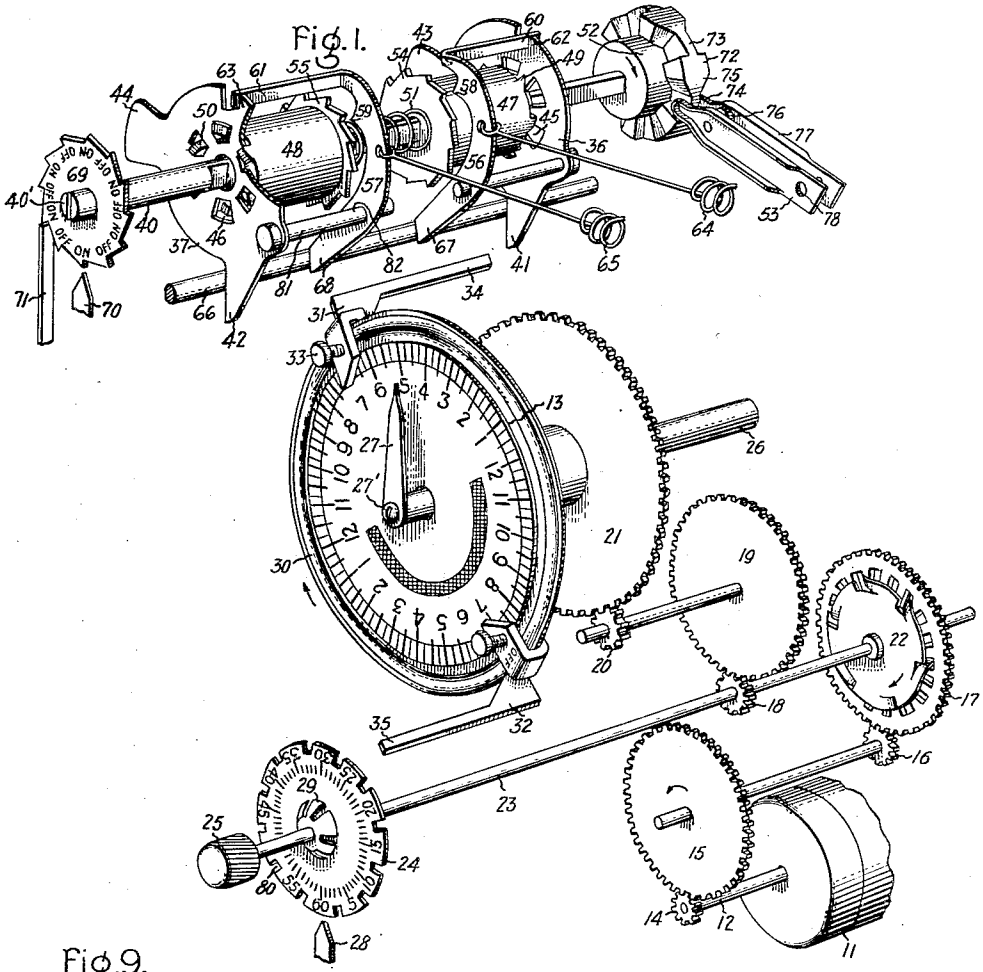


Fig. 9.

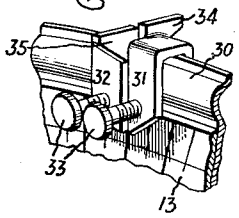


Fig. 5.

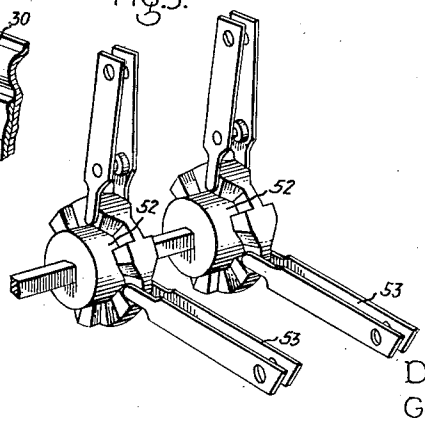
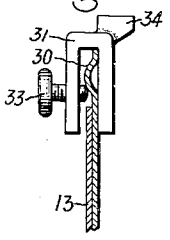


Fig. 4.



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Filed Sept. 18, 1935 3 Sheets-Sheet 2

Fig. 2.

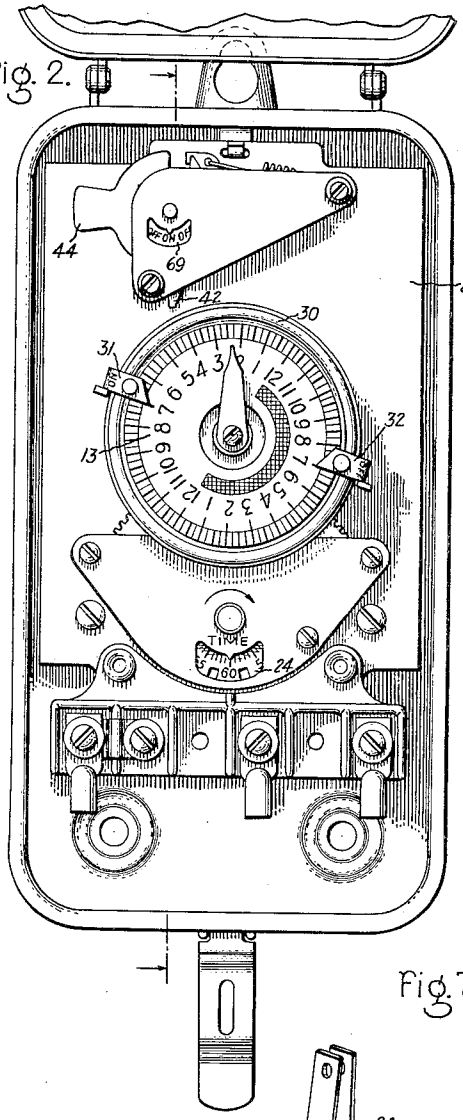


Fig. 3.

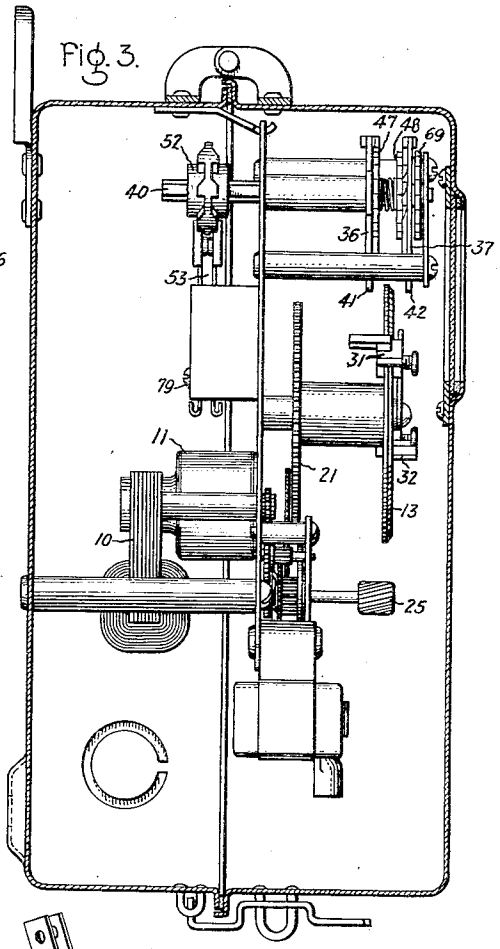


Fig. 7.

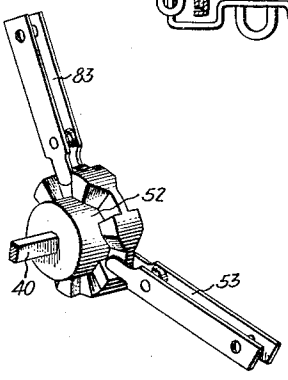
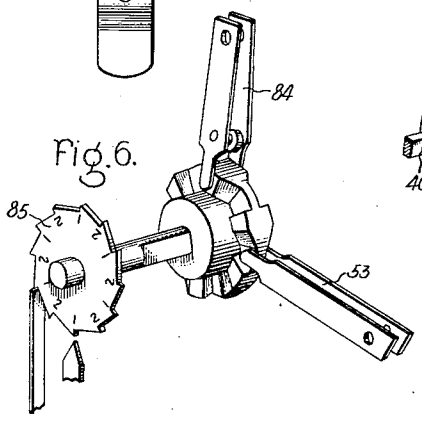


Fig. 6.



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Feb. 7, 1939. D. G. CAMERON ET AL 2,146,562

TIME SWITCH

Filed Sept. 18, 1935 3 Sheets-Sheet 3

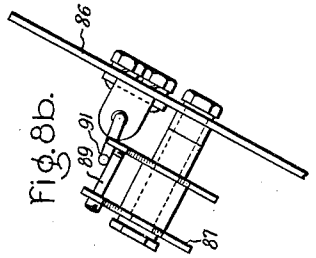


Fig. 8b.

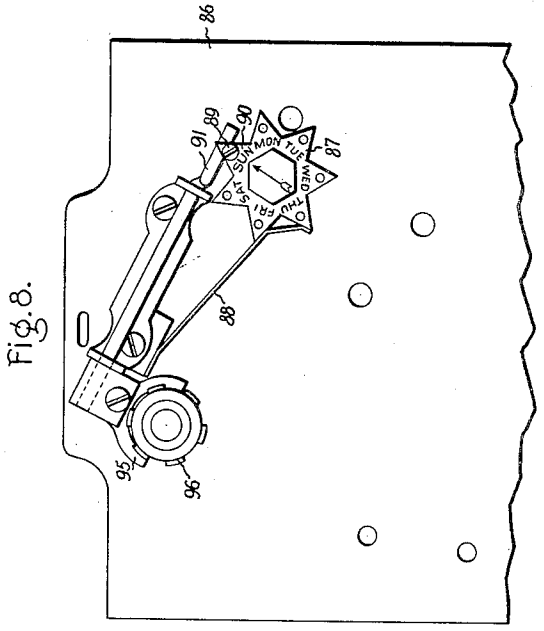


Fig. 8.

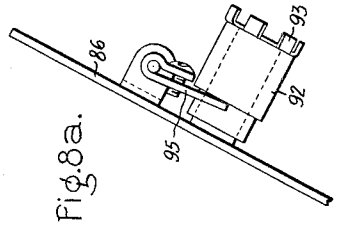


Fig. 8a.

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Patented Feb. 7, 1939

2,146,562

UNITED STATES PATENT OFFICE

2,146,562

TIME SWITCH

Donald G. Cameron and George W. Sprenger, Lynn, Mass., assignors to General Electric Company, a corporation of New York

Application September 18, 1935, Serial No. 41,090

14 Claims. (Cl. 200—38)

Our invention relates to time switches and concerns particularly switches of the type in which the operating energy is gradually stored by a motor and suddenly released in order to produce fast and powerful action at the desired instant.

One of the objects of our invention is to provide a highly efficient tripping mechanism for the switch and thereby reduce the load on the motor and lengthen the life of the switch.

Another object of our invention is to provide a positive indexing system for advancing the switch mechanism precisely to a predetermined position upon each operation without overtravel, and for accomplishing this purpose without wastage of energy.

Still another object of our invention is to provide a switch blade and operating arrangement which provides positive switching and acts with great force at the contacts, themselves, although employing relatively light force-producing elements.

Other and further objects and advantages will become apparent as the description proceeds.

The features of our invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of the invention, reference is made in the following description to the accompanying drawings in which Fig. 1 shows an extended perspective view of the operating mechanism of our switch; Figs. 2 and 3 show front and side views of the commercial form of our switch together with an enclosing casing therefor, in Fig. 2, the hinged door of the casing being open and, in Fig. 3, the casing being closed but shown in section; Fig. 4 is a detail view pertaining to the dial and the trigger-operating rider thereon; Figs. 5, 6 and 7 illustrate different possible arangements of the switch contacts and the operating cams therefor; Figs. 8, 8*a* and 8*b* are detail views of an omitting arrangement; and Fig. 9 is a detail view of a portion of the dial with a pair of riders mounted thereon.

The timing of the switch is effected and all of the operating energy therefor is supplied by a suitable timing motor which is preferably a self-starting synchronous motor where regulated frequency alternating-current supply is available. The synchronous motor is best shown in Fig. 3 at 10. This is a high-speed self-starting motor driving unit of the type described in Warren Patent No. 1,495,936, May 27, 1924, and includes a casing 11 enclosing the rotor of the motor in the reduced portion thereof and a suitable reduction gear train in the enlarged portion thereof to reduce the speed of the motor from usually 3600 revolutions per minute to usually one revolution per minute at the terminal shaft 12 shown extending from casing 11 in Fig. 1.

The timing motor unit drives the time-switch dial 13 at one revolution in twenty-four hours in a clockwise directon through a gear train including gears 14, 15, 16, 17, 18, 19, 20 and 21. Between gears 17 and 18 of this gear train is a one-way driving clutch consisting of a toothed disc 22 fastened on shaft 23 with gear 18 and cooperating with notched openings in the face of gear 17. The gear reduction is such that shaft 23 normally rotates at one revolution per hour, and this shaft is provided with a disc 24 having its periphery graduated in minutes and with a thumb piece 25 by means of which the dial 13 may be turned in the normal direction of rotation manually to set the same accurately with respect to the time of the day. The dial 13 may be advanced manually through the turn button 25 in order to check the setting of the switch for time of operation.

The clutch device 22 is more fully explained in copending application, Serial No. 728,124, May 29, 1934, to Hottenroth, Blanchard and Sprenger, assigned to the same assignee as the present invention.

The dial 13 and gear 21 are fastened to the same hub and are not relatively adjustable. They rotate on a stationary shaft 26 which has a stationary time-indicating pointer 27 secured thereto in front of dial 13. The pointer 27 cooperates with 24-hour A. M. and P. M. graduation marks on dial 13 and the rotary minute dial 24 cooperates with a stationary pointer 28 so that the time in hours and minutes is given by these two dials. Furthermore, the minute dial 24 is secured to shaft 23 by friction washers, one of which is shown at 29 so that in a setting operation the minute dial may be adjusted on its shaft to indicate accurate time with respect to pointer 28. In other words, when the pointer 27 is on an hour graduation, the pointer 28 should indicate 60 on the minute dial 24.

The hour dial 13 may be made up of a thin disc having a stiffening ridge or rib 30 near its periphery (see Fig. 4) and another thin disc carrying the time graduations. However, the graduations may be lithographed directly on the disc having the stiffening ridge 30, so that the hour dial 13 consists of a single piece. The ridge 30 serves also as a convenient means of adjustably securing the switch-operating riders 31 and 32 on the hour dial. This is best shown in Fig. 4 where

it will be noted that the rider 31 has spaced parallel parts which straddle the edge of disc 13 and extend inwardly to a point beyond the ridge 30. The rib 30 is rounded so as to slope downward from its top or highest portion, the inner slope being toward the center of the dial. The downward direction is here considered to be toward the back of the dial 13. A thumb screw 33 is threaded through the outer branch part of the rider at a point opposite the inner slope of ridge 30 so that, by tightening the set screw 33, the rider is drawn radially inward until the periphery of the dial rests tightly against the inner end section of the split portion of the rider and it is clamped securely in place. By loosening set screw 33 slightly, the rider may be adjusted about the dial but it cannot drop off and become lost unless the set screw is unscrewed a considerably greater distance than is required for such adjustment.

One edge of the front branch of each rider extends over the hour graduations on dial 30 so as to facilitate accurate setting with respect to the hour and quarter hour graduations thereon. The exact time-setting, however, is obtained by referring to the indications given by minute dial 24. The "on" and "off" riders are similar and interchangeable, having both branches threaded to permit removing the screw 33 and reversing the rider. They have offset laterally-extending fingers 34 and 35 for operating the cocking members 36 and 37, respectively, of a novel switch-operating and detent mechanism. The offset of the fingers 34 permits the "on" and "off" riders to be set in contact with each other with their fingers in alignment, as illustrated in Fig. 9. With such a setting, the "on" and "off" operations can, if desired, be made to occur simultaneously.

The switch-operating and detent mechanism is assembled about and is largely supported by a rotary shaft 40. The cocking members or triggers 36 and 37 are loosely mounted upon the shaft 40 and include, respectively, downwardly projecting noses 41 and 42 adapted to be engaged by the fingers 34 and 35, and arms 43 and 44 for operating the switch manually when desired. The triggers 36 and 37 are provided with circularly arranged groups of slots 45 and 46, and ratchet members 47 and 48 are provided having axially extending groups of ratchet teeth 49 and 50 adapted to engage the groups of slots 45 and 46, respectively. The ratchet members 47 and 48 are mounted upon the shaft 40 in a manner that leaves them free to move axially but constrains the shaft 40 and the ratchet members 47 and 48 to rotate together. For example, the shaft 40 may have flattened sides and the holes in the ratchet members 47 and 48 may be shaped to conform. A compression spring 51 is provided to hold the ratchet members 47 and 48 against the triggers 36 and 37.

The shaft 40 also carries one or more contact-operating insulating cams about each of which is radially arranged one or more pairs of contact blades. In Figs. 1 and 3, only one contact-operating cam 52 and one pair of switch blades 53 are shown. The cam 52 is also mounted to rotate with the shaft 40 but is left free to float axially.

The embodiment of the invention illustrated is designed for rotation of the contact-operating cam 52 in the direction of the arrow thereon in Fig. 1, i. e., in a clockwise direction when viewed from the front of the apparatus, which will be referred to as the forward direction of rotation. It will be observed that the groups of ratchet teeth 49 and 50 of the ratchet members 47 and 48 are so arranged that the triggers 36 and 37 can produce only forward rotation of the ratchets and the shaft 40. The ratchet members 47 and 48 are provided also with radially extending groups of ratchet teeth 54 and 55, forming a second ratchet system on each of the ratchet members 47 and 48. A pair of detent pawls 56 and 57 are pivotally mounted upon the triggers 36 and 37, respectively. These detent pawls have detents 58 and 59 adapted to engage the ratchet teeth 54 and 55 under circumstances which will be explained later in order to prevent overtravel. It will be understood that the ratchet members 47 and 48 are distorted in their axial dimensions in Fig. 1 for the sake of clarity, and that each of these ratchet members may be formed from sheet material as a unitary ratchet wheel with teeth cut in the periphery and teeth partially cut and bent out from one face, as shown in small scale in Fig. 3.

The detent pawls 56 and 57 carry spurs 60 and 61 normally abutting ears 62 and 63 formed in the triggers 36 and 37, and tension springs 64 and 65 are provided which tend to rotate the detent pawls 56 and 57 and the trrigers 36 and 37 in a forward direction. However, a stop 66 is provided and the detent pawls 56 and 57 are provided with tails 67 and 68 which limit forward rotation under the force of the springs 64 and 65. The tails 67 and 68 are so shaped that they abut the stop 66 while there is still clearance between the noses 41 and 42 of the triggers 36 and 37 and the stop 66. The radial distance from the center of the shaft 40 to the pivot points of the detent pawls 56 and 57 is less than the radial distance from the shaft 40 to the stop 66 so that forced rotation of the triggers 36 and 37 beyond the points where the tails 67 and 68 abut the stop 66 produces backward rotation of the detent pawls 56 and 57 relative to the triggers 36 and 37, thus flexing the springs 64 and 65. The springs 64 and 65, therefore, tend to oppose rotation of the triggers 36 and 37 in either direction from the points at which the tails 67 and 68 abut the stop 66.

A semaphore 69, rigidly mounted on the shaft 40 and carrying suitable indices such as the words "on" and "off", numbers, or other marks, is provided, cooperating with an indicating pointer 70 to indicate the switch positions. The semaphore 69 may also be formed as a ratchet wheel to cooperate with a detent 71 to act as a check ratchet, preventing backward rotation of the shaft 40 and the parts carried thereon.

The contact-operating cam 52 is arranged to have its thickness, i. e., one of its dimensions, such as a radial or axial dimension, alternately increasing and decreasing in order to open and close electrical contacts as it is rotated to successive positions. By arranging it as shown with alternate thick and thin portions adapted to ride between extending tips 74 of the contact blades 53, it is possible to operate a large number of pairs of contact blades with a single cam 52. Preferably, the leading edges 75 of the thick portion 72 are tapered in order to provide a wedging action, producing great force for separating the contact blades 53, ample force, if necessary, to separate frozen or welded contacts, even though relatively light springs 64 and 65 are employed. Preferably, the contact blades 53 carry confronting contact buttons 76 of rela-

tively large surface area composed of high conductivity material and at which the electrical circuit is actually made and broken.

To assure positive contact opening in case of welded contacts, we consider it desirable to make the contact blades quite stiff from a point near their pivot or flex point to a point beyond the portion carrying the contact buttons 76 and the portion engaging the operating cam 52, viz., the extending tips 74 in the specific construction illustrated. The contact buttons 76 are also mounted relatively near the extending blade tips 74. To obtain stiffness without sacrificing lightness, ridges or flanges 77 are provided on the blades 53. By omitting the flanges 77 near the portions of the blades near the holes 78, these portions of the blades 53 are left flexible. Accordingly, the blades 53 may be mounted by clamping them to either side of a suitable supporting block (not shown) by means of a screw 79 (visible only in Fig. 3). The flexible portions of the blades 53, therefore, provide a resilient mounting of the contacts 76, permitting their separation during the open position and bringing them together for the closed position of the time-switch mechanism.

Our construction makes it unnecessary to pay particular attention to contact adjustments or alignment of switch blades since both blades are free to move and the operating cam is also free to move axially and align itself with the blades.

The times at which the switch contacts 76 are opened and closed depend upon the position on the dial 13 of the "off" rider 32 and the "on" rider 31. The time-setting may be read more exactly from the minute dial 24.

The adjustment of the apparatus may be carried out as follows:

One of the riders is set at some position on the hour dial, say at the twelve o'clock graduation. The time-setting knob 25 is then turned until the rider operates its corresponding trigger, either 37 or 38, and trips the mechanism operating the switch contacts. The clutch 22 is made to slip during this operation. At the instant of tripping, the turning of the knob 25 is stopped. Then without disturbing anything else, the minute dial 24 is adjusted until the proper minute is indicated, in this case 60. A suitable implement may be inserted in one of the slots 80 in order to adjust its minute dial 24 while the knob 25 is held stationary and the clutch 29 is caused to slip. The hour dial pointer 27 is adjusted to the proper graduation, in this case twelve o'clock, by momentarily loosening the screw 27'. The switch is now completely adjusted as regards timing.

The riders may subsequently be set at any desired positions. One rider can be set to operate accurately by repeating the procedure outlined above. Any other riders are set by means of the graduations of the 24-hour dial 13, and the precise time-setting is checked by rotating the knob 25 and observing the reading of the minute dial 24 at the instant of tripping.

It will be understood that, except when checking the setting of the riders, the knob 25 will not be utilized to operate the switch since rotation of the knob 25 necessitates resetting the switch for the time of the day. If the motor 11 has been shut off for any reason, the knob 25 will, of course, be utilized for resetting the dials to the correct time of day. If it is desired to operate the switch blades manually, this may be done without interfering with the time-of-day reading of the switch by pulling down one of the arms 44, or by rotating the shaft 40 by means of a screw driver inserted in the slot 40'.

The motor 11 effects the timing of the switch by driving the dial 13 at the proper uniform speed, and supplies the energy for opening and closing the contacts by stressing the springs 64 and 65 and cocking the trigger and ratchet mechanisms. In Figs. 1, 2, and 3, the apparatus is shown in the "on" position with the contact buttons 76 together. When the finger 35 of the "off" rider 32 engages the nose 42 of the trigger 37, it gradually rotates the trigger 37 in a backward direction (with respect to the desired forward direction of rotation of the contact-operating cam 52) against the force of the spring 65. After the trigger 37 has been rotated sufficiently, the ratchet teeth 50 drop into the slots 46 but the finger 35 continues to rotate the trigger 37 backward through a predetermined "excess angle" when the finger 35 rides off the end of the nose 42 and releases or trips the trigger 37. The spring 65 thereupon snaps the trigger in a forward direction and the trigger 37 acquires considerable momentum while retracing the "excess angle" just mentioned. The edges of the slots 46 serving as detents then engage the ratchet teeth 50 and rotate the ratchets, the shaft 40, and the cam 52 through an angle equal to the angular distance between the thin and thick portion 73 and 72 of the cam 52. Under the combined effect of momentum of the trigger 37 and the continued force of the spring 65, the thick portion 72 of the cam 52 is driven with great power and rapidity between the blade tips 74, and the switch contacts 76 are opened.

After the cam 52 has been rotated the requisite angle, the tail 68 of the detent pawl 57 strikes the stop 66 while the trigger 37 still retains some of its momentum. This momentum is not wasted, however, but serves to rotate the detent pawl 57 backward around the pivot pin 81 and to drive the detent 59 in before the adjacent ratchet tooth of the group of ratchet teeth 55 on the ratchet member 48. The forces acting upon the detent pawl 57 at the pivot point 82 and at the support 66 as a result of the momentum of the trigger 37 form a couple or a torque which rotates the detent pawl 57 backward. In this way, overtravel of the contact-operating cam 52 is prevented and the angular position of the shaft 40 is precisely indexed. The spring 65 draws the detent 59 away from the ratchet teeth 55 as soon as the parts have come to rest and leaves the mechanism free for a subsequent operation.

In a manner similar to that just described, the finger 34 of the rider 31 at the proper time engages the nose 41 of the trigger 36 and the parts associated therewith are actuated to move the apparatus to the "on" position again with the contacts 76 closed. Two riders are illustrated but obviously any desired number of riders may be added.

It will be observed that, in the apparatus illustrated, the cam 52 has twelve "on" and "off" positions, six of each, whereas the triggers 36 and 37 each have six slots corresponding to six ratchet teeth in each group 49 and 50. The two switch-operating mechanisms associated with the triggers 36 and 37 operate alternately, one bringing about the six "on" positions and the other the six "off" positions. The use of separate mechanisms for closing and opening the contacts 76 guards against an incorrect operation at the predetermined time in case the switch has already been opened or closed manually. However, if this

feature is not required, it will be understood that a single switch-operating and detent mechanism may be employed having a number of slots 46 and ratchet teeth 50 corresponding to the number of angular positions of the cam 52.

In Figs. 1, 2, and 3, the apparatus is arranged as a single-pole, single-throw switch. By adding a second pair of contact blades 83 as in Fig. 7 with the angular spacing between pairs of blades such that the pairs of contacts open and close together, a double-pole single-throw switch is produced. The same result may be accomplished by adding additional cams with corresponding blades. Owing to the efficiency of our tripping mechanism, a large number of contacts may be operated without undue load on the motor 11.

A single-pole double-throw switch is represented in Fig. 6, in which the blades 53 and 84 are so arranged that one pair is open while the other pair is closed. In this case, the semaphore 85 is provided with numbers 1 and 2 to indicate which circuit is closed instead of the words "on" and "off". Similarly, a double-pole double-throw switch is shown in Fig. 5.

The apparatus may also be used with an omitting device for suspending switch operation on certain days of the week or month, with a two-circuit arrangement for causing two different circuits to be turned off or on at different times, with an astronomical dial such as that described in the above mentioned copending application of Hottenroth, Blanchard, and Sprenger, or in United States Patent No. 1,891,946 to Porter instead of with the plain dial 13, or with other desired features. It is, therefore, evident that our apparatus is truly a general-purpose time switch with which a wide variety of switching combinations may be obtained by the addition or substitution of various interchangeable parts.

An omitting device is illustrated in Fig. 8. There is rotatably mounted upon the same plate 86 carrying the other apparatus shown in Figs. 1, 2 and 3, a star wheel 87 having seven points corresponding to and marked with the seven days of the week. The star wheel is so mounted that it is engaged by the "on" rider 31 and turned through the angular distance of one point each time the "on" rider passes. Preferably, a spring 88 is provided to prevent the star wheel 87 from spinning and to keep it in the proper angular position. Each point is adapted to receive an omitting pin. For example, a pin 89 may be secured in the "Sunday" point 90. A rotatably mounted crank 91 is provided, which is adapted to be engaged and oscillated by the omitting pin 89. A crown wheel 92 having prongs 93 adapted to enter the slots 45 of the trigger 36 (Fig. 1) is mounted surrounding the shaft 40 under the trigger 36, being axially slidable but rotating with the shaft 40 and the trigger 36. The opposite end of the crank 91 carries a fork 95 adapted to raise the crown wheel 92 when the crank 91 is oscillated.

It will be apparent that, after the "on" rider 31 has, on Saturday evening, for example, operated the "on" trigger 36, and then moved the star wheel 87 to the position shown in Fig. 8, the omitting pin 89 will oscillate the crank 91 and cause the crown wheel 92 to be raised. The prongs 93 of the crown wheel 92 then enter the slots 45 of the trigger 36 (Fig. 1), push the ratchet teeth 49 upwards, and prevent them from becoming engaged by the slots 45. Consequently, when next (in this case on Sunday evening), the "on" rider operates the trigger 36 at the usual daily time for closing the circuit, the trigger 36 trips without rotating the contact-operating cam 52 and the circuit remains open.

When the "off" rider next trips the trigger 37, the switch is already in the "off" position and no rotation of the cam 52 takes place owing to the fact that the ratchets are arranged to operate only alternately. The triggers 36 and 37 have only half as many slots as the cam 52 has positions. Therefore, although the trigger 37 is oscillated, the ratchet teeth 50 ride into the solid portions between the slots 46, cannot drop into the next slots, and no rotation of the shaft 40 is produced.

We have herein shown and particularly described certain embodiments of our invention and certain methods of operation embraced therein for the purpose of explaining its principle and showing its application but it will be obvious to those skilled in the art that many modifications and variations are possible and we aim, therefore, to cover all such modifications and variations as fall within the scope of our invention which is defined in the appended claims.

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

1. In a cam-operated switch mechanism, a switch-operating cam for alternately opening and closing the switch, a pair of ratchets mechanically connected thereto with respect to angular motion, a pair of biasing springs, a pivotally mounted switch-opening trigger biased by one of said springs and having a pawl adapted to engage one of the ratchets when moving with the force of the spring, a pivotally mounted switch-closing trigger biased by the other of said springs and having a pawl adapted to engage the other of said ratchets when moving with the force of the spring by which it is biased, means for deflecting said switch-opening trigger gradually against the first of said springs and releasing the trigger at a predetermined time when a switch-opening operation is to take place and means for deflecting said switch-closing trigger gradually against the force of its spring and releasing the trigger at a predetermined time when a switch-closing operation is to take place.

2. In a cam-operated switch, a pair of flexible contact blades both adapted to be moved away from each other and having extending tips, a substantially circular insulating cam having relatively thick and thin portions adapted to engage and ride between said blade tips, the dimensions being such that said blades make electrical contact when a thin portion of said cam lies between said blade tips and said blades are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam a step at a time, each step representing the angular distance between a thick and a thin portion of said cam.

3. In a cam-operated switch, a pair of relatively movable contact blades having extending tips, a substantially circular insulating cam having relatively thick and thin portions adapted to engage and ride between said blade tips, the dimensions being such that said blades make electrical contact when a thin portion of said cam lies between said blade tips and said blades are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam a step at a time, each step representing the angular distance between a thick and a thin portion of said cam.

4. A cam-operated switch comprising in com-

bination, a rotatable shaft, a substantially circular insulating cam slidable axially on said shaft but constrained to rotate therewith, a pair of relatively movable contact blades having extending tips lying on either side of a portion of said cam and confronting contact buttons secured to said blades intermediate the extremities thereof, said cam having axially measured relatively thick and thin portions adapted to come between said blade tips successively as said cam is rotated and of such dimensions that said contact buttons make electrical contact when a thin portion of said cam lies between said blade tips and said contact buttons are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam in steps, each step representing the angular distance between thick and thin portions of said cam.

5. In a cam-operated switch, a pair of relatively movably mounted blades having extending tips, carrying confronting contacts intermediate the extremities of the blades, and each being relatively rigid from the end of its tip to a point beyond the contact, a substantially circular insulating cam having relatively thick and thin portions adapted to engage and ride between said blade tips, the dimensions being such that said contacts make electrical contact when a thin portion of said cam lies between said blade tips and said contacts are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam a step at a time, each step representing the angular distance between a thick and a thin portion of said cam.

6. A cam-operated switch mechanism comprising in combination, a pair of relatively movable contact blades of flexible material clamped at one end, each having ribs formed thereon extending from a point intermediate the clamped end and the tip of the other end whereby to stiffen said ribbed portion, confronting contacts on said ribbed portions intermediate the extremities thereof, a cam having relatively thick and thin portions adapted to ride between said blade tips and of such dimensions that said contacts make electrical contact when a thin portion of said cam lies between said blade tips and said blades are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam in steps, each step representing the angular distance between thick and thin portions of said cam.

7. A cam-operated double-throw switch comprising in combination, two pairs of relatively movable contact blades having extending tips, cam means having alternately relatively thick and thin portions adapted to engage and ride between the blade tip of either pair of blades, the dimensions being such that the blades of a pair thereof make electrical contact when a thin portion of said cam lies between the tips of said blades and said blades are out of contact when a thick portion of said cam lies between said blade tips, and means for rotating said cam means a step at a time, each step representing the angular distance between thick and thin portions of said cam means, said pairs of contact blades being at such an angle to each other that one pair of blade tips engages a thick portion of said cam means while the other pair engages a thin portion of said cam means.

8. In a time switch, a timing motor, a 60-minute shaft, a 24-hour shaft, step-down gearing between said timing motor and said 60-minute shaft and between said 60-minute shaft and said 24-hour shaft, a 24-hour dial on said 24-hour shaft, a 60-minute dial, a slipping clutch joining said 60-minute dial and said 60-minute shaft, means for manually rotating said 60-minute shaft, and means associated with said 60-minute dial for holding it stationary while its shaft is turned.

9. A switch comprising in combination, a pair of relatively movable contact blades, a rotary cam in operative relation with said blades, a ratchet member with which said cam is constrained to rotate, said ratchet member carrying two sets of teeth forming two ratchets, a pivotally mounted trigger having an ear thereon and including a detent adapted to cooperate with one of said ratchets to produce rotation of said ratchet and said blade-operating cam in a forward direction, a stop, a detent pawl pivotally mounted on said trigger, having a spur engaging said trigger ear when said detent pawl is rotated in a forward direction, means attached to said detent pawl tending to produce forward rotation thereof and of said trigger, said detent pawl having a tail adapted to engage said stop to limit forward rotation of said detent pawl and having a detent adapted to cooperate with said second ratchet to prevent overtravel thereof when the momentum of said trigger draws its ear away from the spur of said detent pawl, and means for deflecting said trigger against the force of said forward rotation producing means and abruptly releasing said trigger.

10. A two-position cam-operated switch comprising in combination, a pair of relatively movable contact blades, a rotary cam in operative relation with said blades and having a plurality of equally spaced angular positions alternately corresponding to two different switch contact positions, a pair of ratchets with which said cam is constrained to rotate, a pair of pivotally mounted triggers, each including a pawl adapted to engage with one of said ratchets in half as many angular positions of said ratchet as there are angular positions of said blade-operating cam, said ratchets being angularly so arranged with respect to each other that they are alternately in a position to be engaged by the corresponding pawl when the trigger including said pawl is rotated forward, means resiliently biasing said triggers to forward rotation, and means for rotating a trigger backward and for releasing it at a predetermined time.

11. In a cam-operated switch, a cam-carrying shaft, a spring biased trigger including a detent, means for cocking and releasing said trigger, a ratchet with which said shaft is constrained to rotate adapted to be engaged by said detent upon release of said trigger, a detent pawl pivotally mounted upon said trigger and including a detent, a second ratchet constrained to rotate with the first and adapted to cooperate with said second detent, a stop, said second detent being normally out of engagement with said second ratchet but being driven into engagement therewith to stop said cam-carrying shaft with precision at a predetermined angular position when said detent pawl is driven against said stop by the momentum of said released trigger.

12. A rider for a time-switch dial comprising a pair of parallel branches joined by a neck to form a U, transverse tapped holes in said branches, a fastening screw adapted to be threaded into either of said branches, and a switch-operating finger attached to the neck of said rider unsymmetrical

with respect thereto and extending in a direction transverse to said branches.

13. An omitting device for a cam-operated switch having a trigger including a rotatable detent and a cam-rotating ratchet with teeth extending in an axial direction adapted to be engaged by said detent and rotated by said trigger, said omitting device comprising, in combination with such a detent and ratchet, a star wheel adapted to rotate in steps and having a pin thereon at an angular position corresponding to the switch operation to be omitted, an axially movable member adapted to bear against said ratchet teeth for holding them out of engagement with said detent, and means deflected by said pin in one angular position of said star wheel, said means being connected to said last mentioned member for moving it axially to separate said detent and said ratchet to prevent engagement thereof.

14. In combination, a rotatable ratchet member carrying two sets of teeth forming two ratchets, a pivotally mounted trigger having an ear thereon and including a detent adapted to cooperate with one of said ratchets to produce rotation of said ratchet in a forward direction, a stop, a detent pawl pivotally mounted on said trigger having a spur engaging said trigger ear when said detent pawl is rotated in a forward direction, means attached to said detent pawl tending to produce forward rotation thereof and of said trigger, said detent pawl having a tail adapted to engage said stop to limit forward rotation of said detent pawl and having a detent adapted to cooperate with said second ratchet to prevent overtravel thereof when the momentum of said trigger draws its ear away from the spur of said detent pawl, and means for deflecting said trigger against the force of said forward rotation producing means and abruptly releasing said trigger.

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