

Feb. 11, 1941.

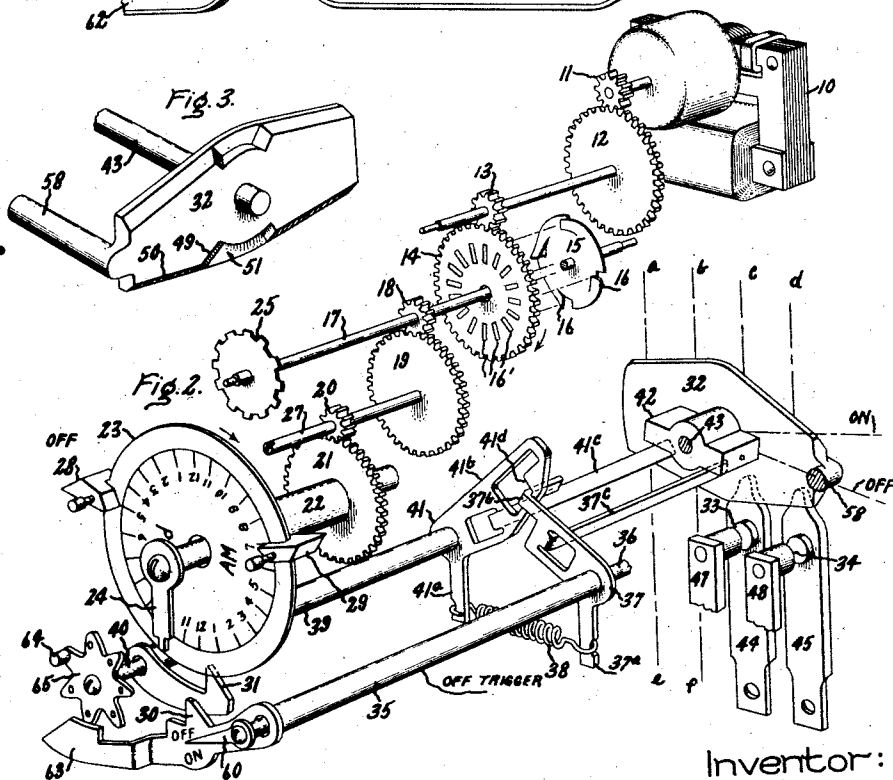
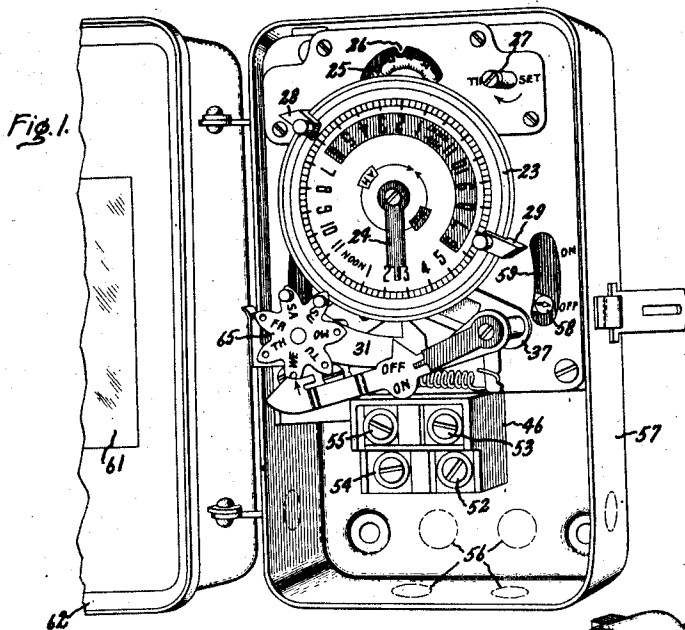
G. W. SPRENGER

2,231,603

GENERAL PURPOSE TIME SWITCH

Filed March 29, 1940

3 Sheets-Sheet 1



Inventor:  
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Feb. 11, 1941.

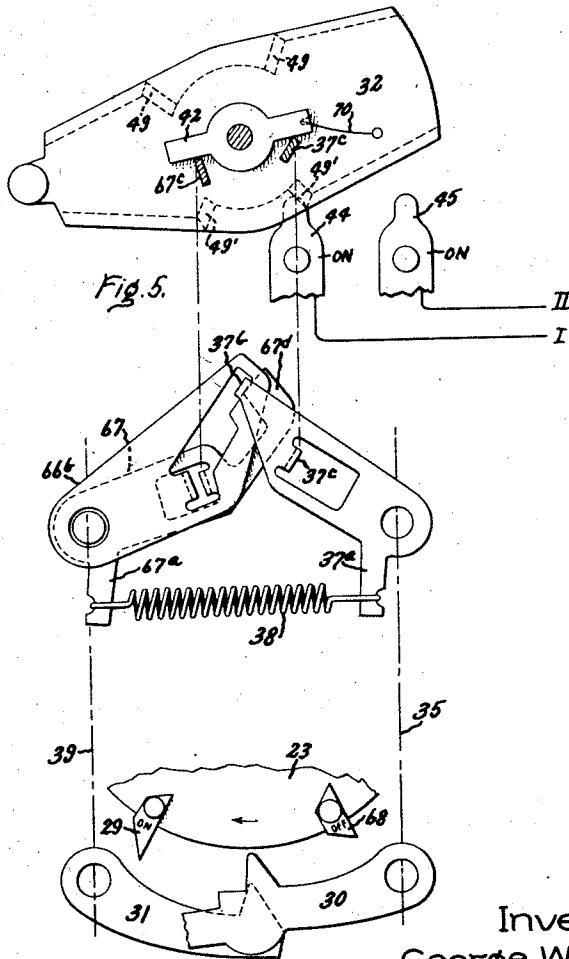
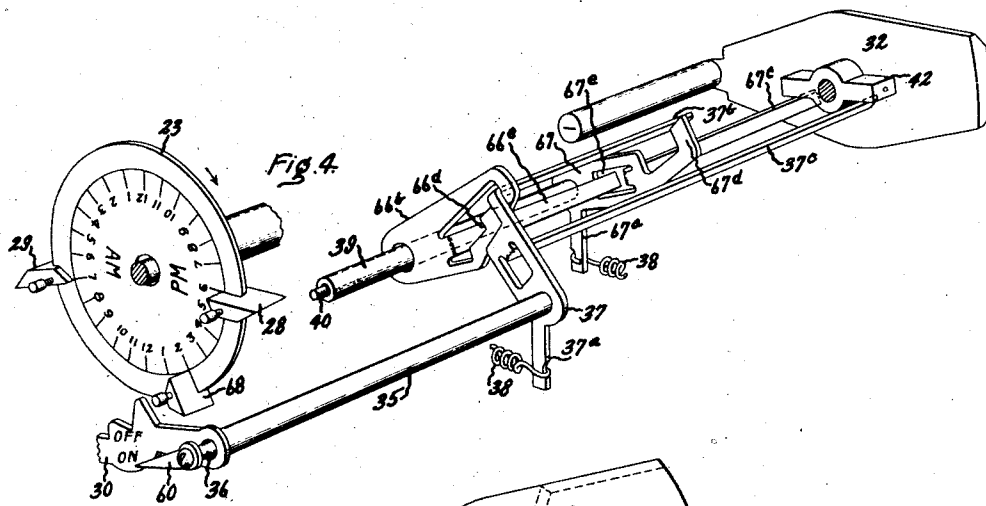
G. W. SPRENGER

2,231,603

GENERAL PURPOSE TIME SWITCH

Filed March 29, 1940

3 Sheets-Sheet 2



Inventor:  
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Feb. 11, 1941.

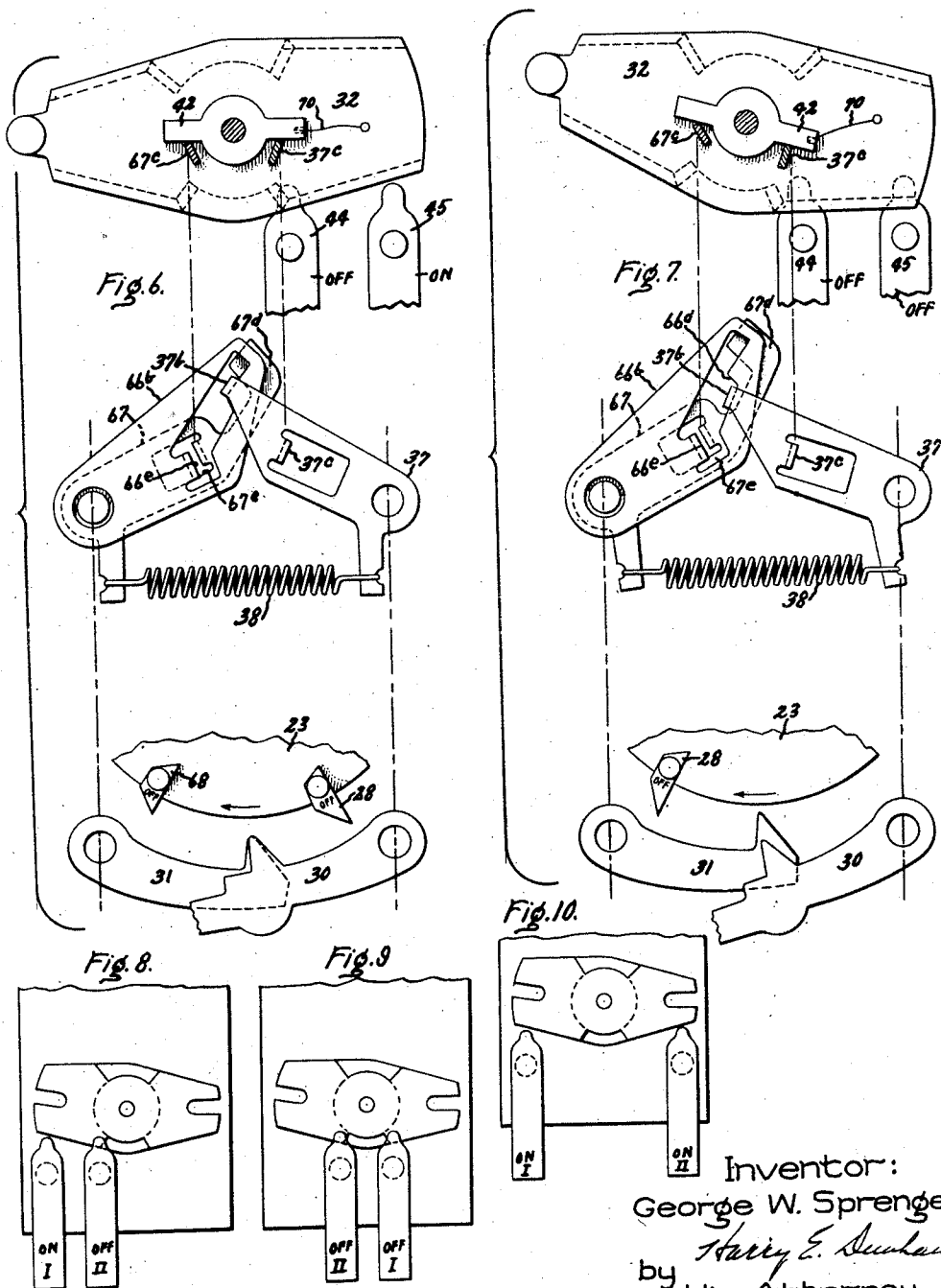
G. W. SPRENGER

2,231,603

GENERAL PURPOSE TIME SWITCH

Filed March 29, 1940

3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE

2,231,603

## GENERAL PURPOSE TIME SWITCH

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New York

Application March 29, 1940, Serial No. 326,698

7 Claims. (Cl. 200—39)

My invention relates to time switches of the type intended to open and close electric circuits at predetermined adjustable times of day, and its object is to provide a relatively small switch of sturdy, simple construction which will be reliable in operation and reasonable in cost and adapted for various uses. An important feature of my invention pertains to an improved trigger operating mechanism for such switches.

The features of my invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of my invention reference is made in the following description to the accompanying drawings in which Fig. 1 shows a front, perspective view of my improved switch as enclosed in a casing with the casing door open; Fig. 2 shows a perspective exploded view of the trigger-operating mechanism of the switch in a simple form for oscillating a switch-operating cam between two positions; Fig. 3 shows a perspective, rear view of the operating cam of such switch; Fig. 4 shows a portion of a modified form of trigger-operating mechanism designed to accomplish the same purpose as the mechanism of Fig. 2, and in addition, to provide an intermediate switch-operating position of the cam; Figs. 5, 6 and 7 are explanatory of the operating mechanism of Fig. 4 in different operating positions; and Figs. 8, 9 and 10 represent contact arrangements for obtaining different switching sequences.

Referring to Fig. 2, the time switch is driven by a suitable timing motor 10 which may be a small, self-starting synchronous motor unit having a relative slow speed terminal pinion 11. Pinion 11 is connected through gears 12, 13 and 14 to a one-way clutch, a portion of which comprises the gear 14. The other portion of this clutch comprises the disk 15 having forwardly bent, resilient clutch fingers 16, which fingers engage with the slots 16' in gear 14 to form a clockwise driving connection between gear 14 and disk 15. It is to be understood that Fig. 2 is an exploded view to show all of the parts but that in practice disk 15 lies close to the rear side of gear 14 so that when gear 14 is driven clockwise by the motor, disk 15 is driven thereby, due to the clutching engagement. Disk 15 is secured on a shaft 17 with a pinion 18 forming a continuation of the gear train which includes gears 19, 20 and 21. In the form of the switch here represented, gear 21 is fastened to a hollow shaft 22 carrying a time-graduated dial 23 on its forward end. The gear relation is such that the

dial 23 is driven in a clockwise direction one revolution in 24 hours and hence its graduations are those of a 24-hour time dial with a. m. and p. m. divisions, as represented. The purpose of the clutch is to permit the manual clockwise advance of dial 23 for time setting purposes. Time is indicated on dial 23 by a stationary pointer 24. The gear relation between shaft 17 and dial 23 is such that shaft 17 has a normal rate of one revolution per hour, and for good accuracy in setting and time reading, shaft 17 carries a dial 25 graduated in minutes and cooperating with a stationary reading pointer 26, both visible above dial 23, as shown in Fig. 1. The forward end of the shaft 27 on which gears 19 and 20 are secured is provided with a knurled surface and with a screw driver slot so that the time dials may be quickly set by turning shaft 27 by the thumb and finger, or, more accurately, by a screw driver. During such time-setting adjustments disk 15 is turned in a clockwise direction and hence the teeth 16 in disk 15 slip by the notches in gear 14 as in a ratchet device. By suitable staggering of the spacing between the ratchet teeth in disk 16 and the ratchet slots in gear 14, the clock drive immediately takes up the forward drive through the clutch following a setting operation without lost motion, and hence without losing the benefit of accurate time setting.

The dial 23 carries two or more riders 28 and 29 which are adjustable about the dial and secured in place opposite the times when certain switching operations are to be performed. Thus, in Fig. 2, rider 28 is an "off" rider and is secured to dial 23 opposite the 5 p. m. time-graduation thereon and hence is intended to perform an "off" switching operation at 5 p. m. Rider 29 is an "on" rider and is set to perform an "on" switching operation at 7 a. m. Rider 28 has a cam surface which projects forward of dial 23 so as to engage operating lever 30 when opposite the time-indicating pointer 24 and move lever 30 downward. Rider 29 has a cam surface projecting rearwardly so as to engage operating lever 31 when opposite the pointer 24 and move lever 31 downward as the rider passes this point. As will more clearly appear later in the description, when lever 31 is moved downward by rider 29, lever 30 returns to the upper position and when lever 30 is moved downward by its rider 28, lever 31 returns to its upper position, which is that represented in Fig. 2. The up and down movements of these levers operate through the connections shown to their rear to oscillate a switch operating cam 32 to open and close switch

contacts such as the pairs of switch contacts 33 and 34 arranged adjacent the cam 32. These connections include a power storage and release trigger mechanism for obtaining snap actions.

5 More specifically, lever 30 is secured to the forward end of a collar shaft 35 pivoted on a stationary post 36 and has secured to it at the rear end of collar 35 a part 37 having a downward extending arm 37a to engage with a spring 38, an  
10 upward extending hooked finger 37b engaging in a slotted part 41b, and a rearwardly extending finger 37c for operating on the cam 32. The parts 30, 35 and 37 are rigidly secured together and operate as a trigger unit. Lever 31 is secured  
15 to the forward end of a collar 39 pivoted on a stationary post 40. The axes of rotation of the two triggers are parallel. To the rear end of collar 39 is secured a part 41 much like the part 37. Part 41 has a downward extending arm 41a  
20 engaging the other end of spring 38. It is seen that the spring is a tension spring tensioned by the opposing pull of the arms 37a and 41a which urges the two triggers to rotate in opposite direc-  
25 tions. Part 41 has a rearwardly extending arm 41c for operating on cam 32, and the upwardly extending slotted arm 41b into which the arm 37b is hooked. This latter connection is a triggering connection which restrains the tendency of the  
30 two triggers to rotate in opposite directions under the urge of spring 38. Parts 31, 39 and 41 are secured together and operate as a trigger unit about post 40 as a pivot. It will be noted that the arms 37c and 41c can strike upwardly  
35 on the lower edges of a horizontally extending projection 42 on cam 32 on opposite sides of the pivot point 43 of the cam. The elongated slot in part 41b has a step 41d over which the hook 37b must pass in moving from one end of the slot to  
40 the other in the cooperative operation of these parts.

The parts just described, namely the parts 37 and 41 and their attachments, constitute a double trigger mechanism and perform in many respects  
45 like a toggle. Cocking of one trigger releases the other to give the switch cam 32 a sharp blow and vice versa for oscillating the cam 32 in opposite directions by strong snap actions through the angle between approximately the lines designat-  
50 ed "On" and "Off" drawn through the pivot 43 of cam 32 and indicating approximately the directions of the longitudinal axis of the cam 32 in its two extreme positions. This may be an angle of about 30 degrees.

55 The cam 32 is made of a hard insulating material and its rear face has beveled surfaces on both upper and lower edges as shown in the rear perspective view Fig. 3. Positioned adjacent its beveled edges is one or more resilient switch con-  
60 tact members such as the members 44 and 45. These members are secured at their lower ends, as indicated in Fig. 2, to the rear face of the insulating terminal block 46 shown in Fig. 1 and  
65 have their upper ends positioned to be moved to the rear by the cam action of the beveled edge of cam 32 when the cam is moved from the "on" to the "off" position. Contact members 44 and 45 cooperate with other relatively stationary contact  
70 members 47 and 48 also secured in the terminal block 46 (Fig. 1) spaced to the front of contacts 44 and 45 and suitably insulated therefrom. In the "on" position of the cam 32 contact members  
75 44 and 45 are allowed to flex forward such that the pairs of contacts at 33 and 34 on the two sets of contact members are closed. In the "off" po-

sition of the cam 32, which is the position shown in Fig. 2, members 44 and 45 are sprung to the rear slightly by the wedging action of the cam to open the contacts. In this wedging action the upper tip of the inner contact member 44 is posi-  
5 tioned to ride over the rise indicated at 49, Fig. 3, while the tip of the outer contact member 45 will ride over that part of the rise indicated at 50. In the "on" position of the cam the upper tip of contact member 44 will be opposite the low part  
10 51 of the cam which helps in preventing any misalignment. The significance of the shape and disposition of the cam surfaces 49 and 50 with respect to the contact members will be further  
15 discussed in connection with the modification shown in Figs. 4 to 7. It will be noted that there are four such wedging cam surfaces on cam 32 and hence the number and disposition of the sets of contacts may be varied as desired. The lines  
20 a, b, c, d, e, and f in Fig. 2 indicate approximately the various positions in which other sets of contact members may be placed to be operated by the oscillation of cam 32. Thus from 1 to 8 sets  
25 of contacts may be operated and certain contacts may be opened when others are closed. Thus contacts placed at e, f, c and d would be opened when the contacts fully shown are closed. Thus  
30 a wide variety of switching arrangements are available and when less than 8 sets of contacts are required, those present may be positioned where it is most convenient from the standpoint  
35 of compact assembly and accessibility for wiring purposes. In general it is most convenient to arrange the contacts below the cam since, as shown in Fig. 1, the terminals thereof are then easily ac-  
40 cessible and convenient to wiring entrance knock-outs in the lower part of the case 57. In Fig. 1 the terminal block 46 is stepped. Lower back terminal 52 connects with contact member 45  
45 while the forward upper terminal 53 connects with contact member 48. Similarly, terminals 54 and 55 connect with contact members 44 and 47, respectively. This stepped arrangement of the terminal block or blocks facilitates easy at-  
50 tachment and proper separation of the wiring. The dotted-line circles such as represented at 56 indicate knock-outs for the entrance of circuit wiring.

Having thus described the main structural fea-  
55 tures, I desire now more fully to describe the operation of the double trigger mechanism. For convenience I may call the parts comprising lever 30, shaft 35, parts 37, 37a, 37b, and 37c, which  
60 operate as a unit, the "off" trigger because when moved by the "off" rider 28, the switches as assembled in Fig. 2 are actuated to the open or  
65 "off" position. Parts 31, 39, 41, 41a, 41b, and 41c will be referred to as the "on" trigger since when moved by the "on" rider 28 the switch is actuated to the closed or "on" position.

In the position of the parts shown in Fig. 2 the switch cam 32 is in the "off" position, the  
70 "off" trigger is at the extreme operating position in the counterclockwise direction, the "on" trigger is in the extreme clockwise operating position, spring 38 is under tension and the arms 37c and 41c are in contact with the under side of the hub extensions at 42 of cam 32, thus main-  
75 taining cam 32 in the position shown. This is a stable condition of the trigger parts which will not be disturbed by jarring or vibration but requires an operating force for any change in the relative position of the parts. Assuming the timing motor is running and the time of the

clock set properly, the next automatic action will occur when the "on" rider 28 rides over the sloping upper surface of lever 31 and moves it downward at 7 a. m. Movement of lever 31 downward results in what may be termed a cocking of the "on" trigger, and a release of the "off" trigger together with a resulting snap action movement of the cam 32 to the "on" position. More specifically, the downward movement of lever 31 first increases the tension of spring 38, moves member 41c away from the lower left surface of hub projection 42 and rotates member 41b with its stepped slot clockwise until hook 37b clears the step at 41d at which time the "off" trigger snaps around in a clockwise direction until the hook 37b strikes the upper end of the slot in 41b. This movement of the "off" trigger is powered by the energy stored in spring 38, and results in driving cam 32 counter-clockwise to the "on" position where it is stopped by arm 41c in its cocked position, since the "on" trigger has now arrived at approximately its full cocked position as rider 28 clears and passes by lever 31.

This is another stable position of the parts and they remain in such position until a subsequent forced operation. The switch contacts 33 and 34 are now closed. The "off" rider next approaches lever 30; the upper cam surface of which has been raised to lie in the path of rider 28 when the "off" trigger was released. Shortly before 5 p. m. rider 28 starts forcing lever 30 downward and cocks the "off" trigger by rotating it counter-clockwise. Spring 38 is tensioned, arm 37c is retracted from contacting position with the under right side of hub 42 and at 5 p. m. hook 37b rides downward over the step 41d in the slot of member 41b. This results in a sudden release of the "on" trigger, arm 41c of which drives cam 32 clockwise to the "off" position. At the same time lever 31 is again raised into the path of rider 28 and rider 28 now clears and passes by lever 30. This completes the recurring cycle of operation which is repeated automatically in accordance with the time setting of riders 28 and 29. The switch contacts are opened and closed quickly and positively due to the quick movement of the cam 32. The mechanism may be operated manually at any time when the riders 28 and 29 are out of the way, and for this purpose the cam 32 may have a handle extension such as shown at 58 which may extend through a slot 59 in the supporting plate or housing, as shown in Fig. 1, so as to be easily accessible for manual operation. It will be evident that the trigger mechanism may be operated just as well by pressure applied through the arms 37c or 41c by such manual operation of cam 32 as by pressure applied on levers 30 or 31. Any desired number of "on" and "off" riders may be used on dial 23 to repeat the "on" and "off" switch operations several times in twenty-four hours, should that be desirable. A suitable indicator or indicators to indicate the "on" or "off" position of the parts may be provided. Thus the position of handle 58 may serve this purpose as represented in Fig. 1. A pointer 60 fixed on post 36 may indicate the "on" and "off" positions marked on lever 30 as represented. Preferably such indication and the time dial are observable through a window 61 in the cover 62 of the time switch casing when the door is closed.

It will be noted that the slot in part 41b is closed and is of such dimensions as to suitably limit either trigger from rotating beyond a predetermined amount in either direction and hence

the trigger parts are prevented from getting out of operative relation. The details of this may be varied without departing from the invention. For example, it is obvious that the slot might be in the "off" trigger and the hook in the "on" trigger. The trigger parts are shown much longer in their axial direction in this exploded view than is necessary or desirable in practice.

In case a day omitting type of switch is desired, the lever 30 may be provided with the extension 63 to cooperate with a pin 64 in a seven-toothed wheel 65. Wheel 65 is mounted to rotate on a pivot that may be secured in the forward end of post 40. Its teeth extend into the path of movement of the "off" rider 28 or a special rider provided for omitting purposes. As shown in Fig. 1, the seven teeth of gear wheel 65 are marked for the days of the week, and the wheel is arranged to be rotated the distance of one tooth each day by a rider and hence makes a complete revolution in a week but stands still most of the 24 hours of each day. If pins 64 are placed in the teeth of the wheel for those days when it is desired to omit the switching "on" operation and such pins are rotated opposite the upper surface of lever extension 63 which is on the "off" lever, such pins will hold the lever down and the "off" trigger in the cocked position and prevent it from operating on such days when the "on" trigger is cocked. Cocking of the "on" trigger when the "off" trigger is thus held in the cocked position simply means that the "on" trigger will return to the uncocked position when the "on" rider 29 passes by lever 31. No "on" switching operation will occur until the pin 64 has passed beyond the holding position with respect to extension 63. An astronomical time variation of the riders may be provided if desired, as described in United States Letters Patent No. 1,891,946, December 27, 1932, without modifying the trigger mechanism.

In Fig. 4 I have shown a modified form of trigger mechanism to be used when more complicated switching operations are to be performed. In this form the switch cam 32 has the extreme "on" and "off" positions explained above and in addition has an intermediate position for effecting additional special switching sequences. For example, it may operate a pair of contact devices as in Fig. 2, both of which are open in the "off" position and one of which is open and the other closed in the additional intermediate position. Moreover, the arrangement is such that two switches may be closed at one time and opened at different times by the same mechanism. To bring this about, the trigger having the slot is made in two relatively movable parts to provide a second step in the slot which is effective in one direction of operation only.

Referring now to Fig. 4, the "off" trigger 37 is the same as in Fig. 2, except that the hook 37b thereon is shown somewhat longer for illustration purposes only. The slotted trigger is made in two parts 66b and 67. The part 67 is secured directly to the sleeve 39 which is rotated by the "on" rider as in Fig. 2. It has the rearwardly extending arm 67c for operating on cam 32 and it has the arm 67a for hooking to the spring 38. In Fig. 4 the spring hooks 37a and 67a appear out of alignment but this is due to the exploded perspective illustration and in practice they will be substantially opposite each other as the corresponding parts are in Fig. 2, and as indicated in Fig. 5. The part 67 has an upwardly extending hook-shaped finger 67d which at times performs

the function of the intermediate step, reference to which has been made above. Part 66b carries the slot having the step 66d therein and through which the hook 37b extends. Part 66b is free to rotate on sleeve 39 but is restrained from extended rotation thereon by reason of having a lug 66e engaging loosely in an opening 67e in part 67 which is fast on sleeve 39. In practice parts 66b and 67 lie close together. The dial 23 has an additional short "on" rider 68 thereon and the switch cam block 32 is reversed end for end as compared to Fig. 2.

It will be noted that the two sides of the cam block 32 are not exactly symmetrical. The inner cam surfaces 49 on the top of the block as shown in Fig. 5 are a greater distance apart than are the corresponding cam surfaces 49' at the bottom of the block.

The reason for this is that the cam surfaces 49 are positioned to favor best operation for the two-position operation explained in connection with Fig. 2, while the cam surfaces 49' are positioned to favor best operation for the three-position operation mechanism of Fig. 4. This point will be clearer after Figs. 5, 6 and 7 have been explained. When the contacts are placed below the block 32 as shown in all figures the block 32 will preferably be positioned as in Fig. 2 when the trigger mechanism there shown is used and it will be turned over to bring the surfaces 49' opposite the contacts when the trigger mechanism of Fig. 4 is used.

The operation of the trigger mechanism of Fig. 4 will now be explained in connection with Figs. 5, 6 and 7 which are diagrammatic representations of the parts in different positions. Starting with the position of the parts represented in Fig. 5, it is noted that the "on" rider 29 of dial 23 has pushed lever 31 down, leaving the trigger mechanism in the position shown and the switch cam 32 in the "full on" position. At this time part 67 is held in the position shown, by reason of the hook 37b restraining finger 67d against the tension of spring 38. Part 66b is not under restraint. The next operation occurs when short "off" rider 68 moves lever 30 about half-way down producing the condition represented in Fig. 6. Here it is seen that hook 37b has been lowered to release finger 67d and the latter has rotated counter-clockwise under action of spring 38 until stopped by the tongue 66e of part 66b, engaging the lower edge of slot 67e in part 67. Part 66b is now restrained because finger 37b now engages the upper stepped surface of its slot. This action has also resulted in first lowering of finger 37c and the snapping upward of finger 67c to move the switch cam 32 to the intermediate position shown in Fig. 6. It is seen that the high cam surface of block 32 has moved under the tip of contact finger 44 and hence its contacts have opened but the contacts controlled by contact finger 45 remain closed.

At some later time, depending upon the setting of the long "off" rider 28, the latter will move lever 30 all the way down to produce the conditions represented in Fig. 7. Here hook 37b has dropped over the step 66d in the slotted member 66b and the parts have arrived at the full "off" position. Part 67 is still restrained by the tongue 66e engaging the lower edge of slot 67e but both parts of the "on" trigger have rotated further counter-clockwise by the amount determined by the height of step 66d. Cam member 32 has thus been rotated with a snap action to the full "off" position represented, this occurring

when hook 37b dropped over the step 66d. Switch contact member 45 has now also been flexed to the rear and hence its contacts are now open. In the meantime lever 31 has been raised in two steps into the path of "on" rider 29.

When rider 29 next moves lever 31 down, the parts return to the condition represented in Fig. 5 in one motion. That is, there is no intermediate step in the "on" operation. In arriving at the condition represented in Fig. 5, part 67 is first rotated clockwise alone but when the upper surface of its slot 67e engages the upper surface of tongue 66e, part 66b is carried along and when finger 37b rides upward over step 66d finger 67d is retracted out of the way so that hook 37b rides directly to the upper end of the slot in part 66b. Thus both switches operated by members 44 and 45 are closed at the same time, determined by the setting of rider 29 but are opened at different times selected by the positions of riders 68 and 28.

It will now be seen that a wide variety of circuit control operations can be performed by the form of the invention represented in Fig. 4 by simply repositioning the contacts used or by changing the circuit connections to different contacts and some of these will now be mentioned.

Fig. 5 shows one arrangement of the contacts for controlling two circuits which I shall designate circuits I and II. Figs. 8, 9 and 10 represent other positions of the contacts which may be used for controlling circuits I and II. In Figs. 8, 9 and 10 the switch cam is represented in the intermediate position only but the switch conditions for the other positions can readily be visualized. For convenience I shall call the three positions of the cam 32 shown in Figs. 5, 6 and 7 as cam positions Nos. 5, 6 and 7, respectively. Then, the switching schedule for the circuits I and II for the different contact arrangements and cam positions will be according to the table given below.

It will be seen that in Fig. 5 those contacts placed to the lower right of the center of the cam block 32 are opened at different times and closed at the same time while those placed to the lower left of the center, as in Fig. 8, are closed at different times but opened at the same time. Further changing of the contacts and the connecting of different switches in series will produce additional varieties of switching schedules, but it is believed that enough examples have been given to illustrate the possibilities in this respect.

| Contact positions  |                 | Cam positions |       |       |
|--------------------|-----------------|---------------|-------|-------|
|                    |                 | #5            | #6    | #7    |
| As in Fig. 5.....  | Circuit I.....  | On..          | Off.. | Off.. |
|                    | Circuit II..... | On..          | On..  | Off.. |
| As in Fig. 8.....  | Circuit I.....  | Off..         | On..  | On..  |
|                    | Circuit II..... | Off..         | Off.. | On..  |
| As in Fig. 9.....  | Circuit I.....  | On..          | Off.. | Off.. |
|                    | Circuit II..... | Off..         | Off.. | On..  |
| As in Fig. 10..... | Circuit I.....  | Off..         | On..  | On..  |
|                    | Circuit II..... | On..          | On..  | Off.. |

It will be seen that to change from the form of switch shown in Fig. 2 to that shown in Fig. 4, I merely replace the "on" trigger 41 with the two part trigger 66b-67 of Fig. 4, add the rider 68 and reverse the cam 32. Also I wish to point out that it is not essential that the cam 32 be assembled as in Fig. 2, for the successful operation of that switch since it has been shown that the switch conditions are the same in the two extreme positions of the cam 32 for both Figs. 2

and 4, although the cam 32 is reversed in these figures. However, the cam surfaces used in Fig. 2 are designed to produce simultaneous opening or simultaneous closing of both contacts, and is a refinement that is not essential for many applications.

Another variation of switching may be obtained by simply leaving off the short rider 68, Fig. 4. In such a case the cam 32 would remain in the intermediate position for a length of time determined by the slope of the cam surface on rider 28. Still another variation of switching would result by adding an "on" rider like 28 between riders 28 and 68 in Fig. 4.

In installations where this switch is likely to be subjected to severe vibration, I prefer to provide a very light whisker-like toggle spring 70 seen in Fig. 7 between the part 42 of cam block 32 and one of the switch supporting plates. The purpose of such a spring is to assure stability of the cam in either of its extreme positions during that short interval of time when the arms 67c or 37c, Fig. 7, are retracted from the part 42 of the cam block 32 just prior to a switching operation. For instance, in Fig. 7 the next switching operation will be preceded by the retraction of arm 67c from the lower left edge of the part 42. Hence at such times the only thing that holds the cam 42 from counter-clockwise rotation is friction unless a toggle spring such as 70 is provided. This spring does not otherwise enter into the operation of the device and is merely a safeguard against possible premature indefinite rotary movement of cam block 32.

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

1. In a time switch, a pair of trigger members mounted for limited rotation on parallel axes, a spring connected between said members and tensioned to urge relative rotation of said members in opposite directions, a triggering connection between said members resisting such relative rotation but arranged to permit triggering action between said members such that rotation of one member in a direction to increase the tension of said spring is followed by a release of the other member and its sudden rotation by a limited amount in a direction to reduce the spring tension and vice versa, the sudden rotary movements of the two members occurring in opposite directions, time controlled means for rotating said trigger members in opposite directions to cause such triggering actions at predetermined times and a switch operating member moved in one direction by the sudden rotation of one of said trigger members and in the opposite direction by the sudden rotation of the other trigger member.

2. In a time switch, a pair of trigger members mounted for limited rotation on parallel axes, a spring connected between said members and tensioned to urge relative rotation of said members in opposite directions, a triggering connection between said members resisting such relative rotation but arranged to permit alternate triggering action between said members such that rotation of one member in a direction to tension said spring is followed by a release of the other member and its sudden rotation by a limited amount in a direction to reduce the spring tension and vice versa, the sudden rotary movement of the two members occurring in opposite directions in single steps of approximately equal magnitude, time controlled means for alternately rotating said trigger members in opposite directions to cause such alternate triggering actions

at predetermined times, and a switch operating member moved in opposite directions by and in response to the alternate sudden rotary movement of said trigger members.

3. In a time switch, a pair of trigger members mounted for limited rotation on parallel axes, a spring connected between said members and tensioned to urge relative rotation of said members in opposite directions, a triggering connection between said members resisting such relative rotation but arranged to permit triggering action between said members such that rotation of one member in a direction to increase the tension of said spring is followed by a release of the other member and its sudden rotation by a limited amount in a direction to reduce the spring tension and vice versa, the sudden rotary movement of the two trigger members occurring in opposite directions, one of said trigger members being made in two relatively movable parts which operate to divide the sudden rotation of said two-part trigger member into two substantially equal steps, the sum of which is substantially equal to the sudden rotary movement of the other member in the opposite direction, time controlled means for rotating said trigger members in opposite directions to cause such triggering actions to occur at predetermined times, and a switch operating member moved in one direction in two steps by the sudden rotations of said two-part trigger member and in the opposite direction in one step by the sudden rotation of the other trigger member.

4. In a time switch, a switch-operating cam member pivoted so as to rotate back and forth between first and second extreme positions, a pair of switches positioned adjacent to said cam and operated to open and closed positions thereby, one switch being operated by movement of the cam from the first extreme position to an intermediate position and the other switch being operated by movement of the cam from such intermediate position to the second extreme position, reverse movement of said cam causing the reverse operations of said switches, and time-controlled means for moving said cam in one direction from the first extreme position to the intermediate position, at one predetermined time, for moving said cam in the same direction from the intermediate position to the second extreme position at another predetermined time and for moving said cam in the reverse direction from the second to the first extreme position at another predetermined time in recurring sequence, said time-controlled means including an energy-storing and energy-releasing trigger mechanism to cause the movements of said cam and the operations of said switches to occur quickly at such predetermined times.

5. In a time switch, an elongated switch-operating cam pivoted near its center for oscillation between extreme positions, said cam being made of insulating material and having opposite edges thereof provided with beveled or wedging surfaces, a plurality of switches positioned adjacent one edge of said cam so as to be operated by the wedged-shaped surfaces thereof when the cam is oscillated between its extreme positions, means whereby said cam may be reversed in position for the purpose of operating said switches by the opposite wedge-shaped surfaces thereof, one of said edges having its wedging surfaces arranged to operate said switches substantially simultaneously and the other edge having its wedging surfaces arranged to operate said

switches at different times in the oscillatory movement of said cam.

6. A general purpose time switch comprising a pair of switches, a cam member for operating said switches, a trigger mechanism for oscillating said cam member, a rotary time dial, three riders adjustably secured on said dial for selectively operating said trigger mechanism and a timing motor for driving said time dial, said trigger mechanism including a spring in which energy may be gradually stored and suddenly released by the operation of said trigger mechanism to cause sudden movement of said cam member at times determined by the time setting of said riders on said time dial, said cam being moved from a given position in one direction at one time, moved further in the same direction at another time and returned in the opposite direction to said given position at a third time in a recurring sequence, said pair of switches being so related to the cam that one is operated during the first cam movement of said sequence, the other is operated during the second cam movement of said sequence and both are operated in the reverse direction during the third cam movement of said sequence.

7. In a time switch, a pair of triggers mounted

for limited rotation on parallel axes, a spring connecting said triggers and tensioned to urge relative rotation of said triggers in opposite directions, a hook on one trigger engaging an elongated slot on the other trigger and serving to maintain tension in said spring and to form a triggering connection between said triggers, time-controlled means for rotating the slotted trigger in a direction to increase the tension of said spring, said movement causing the hooked trigger to rotate in a direction to relieve the spring tension accompanied by movement of its hook from one end of the slot to the other, a second time controlled means for rotating the hooked trigger in a direction to increase the tension of said spring, said movement causing the slotted trigger to rotate in a direction to relieve the spring tension accompanied by a return movement of the hook in the slot, the edge of the slot contacted by said hook having a rise or step therein over which the hook must pass in moving from one end of the slot to the other, whereby such movements occur with a sudden snap action, and a switch closed in response to one of such snap actions and opened in response to the other snap action.

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