

Nov. 30, 1943.

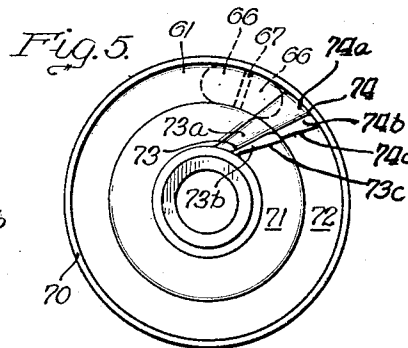
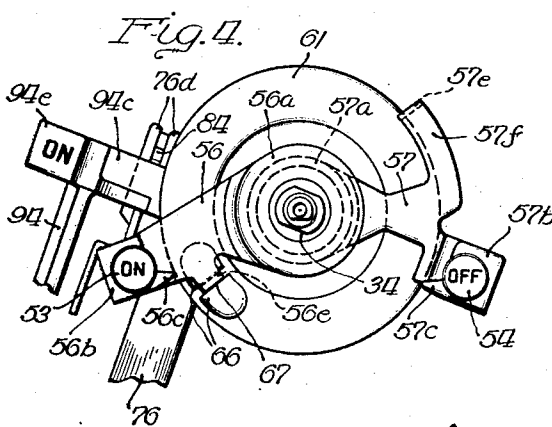
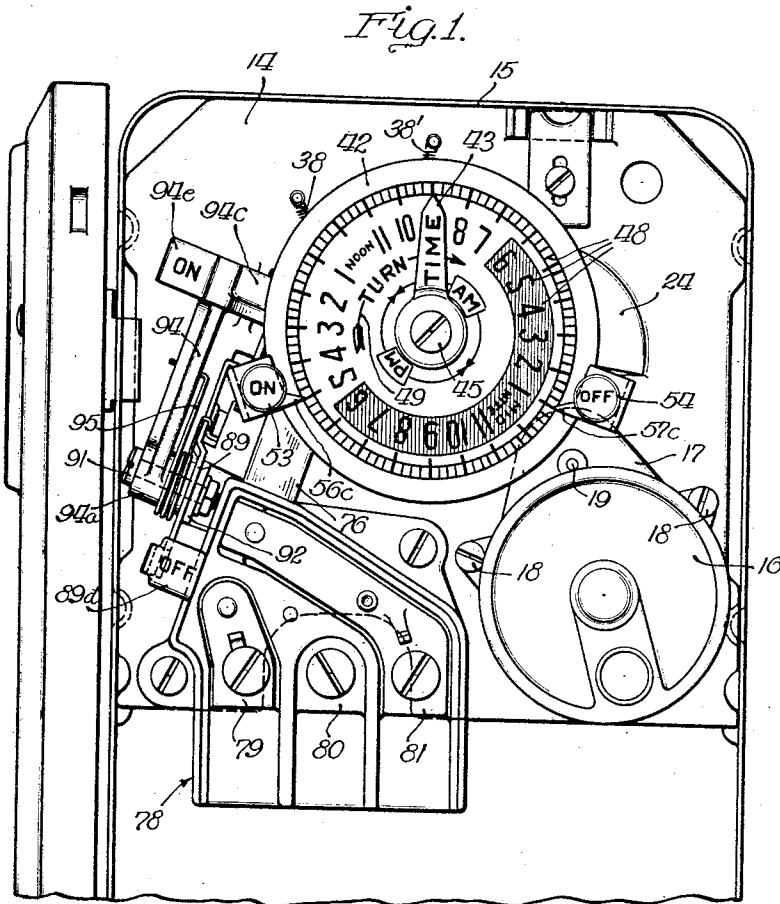
W. P. GALLAGHER

2,335,403

ADJUSTABLE TIME SWITCH

Filed Nov. 3, 1941

5 Sheets-Sheet 1



INVENTOR.
William P. Gallagher
BY
Maurice Bortolotto
Attorney

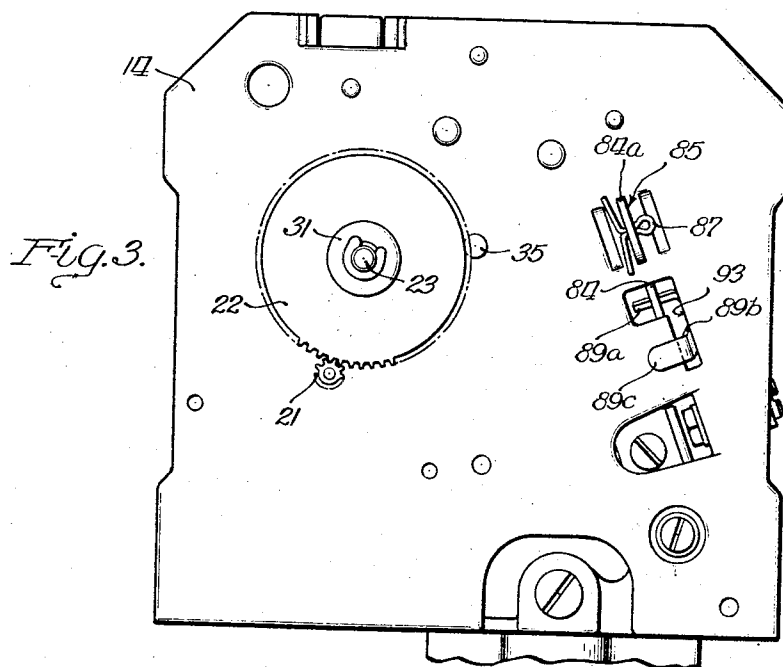
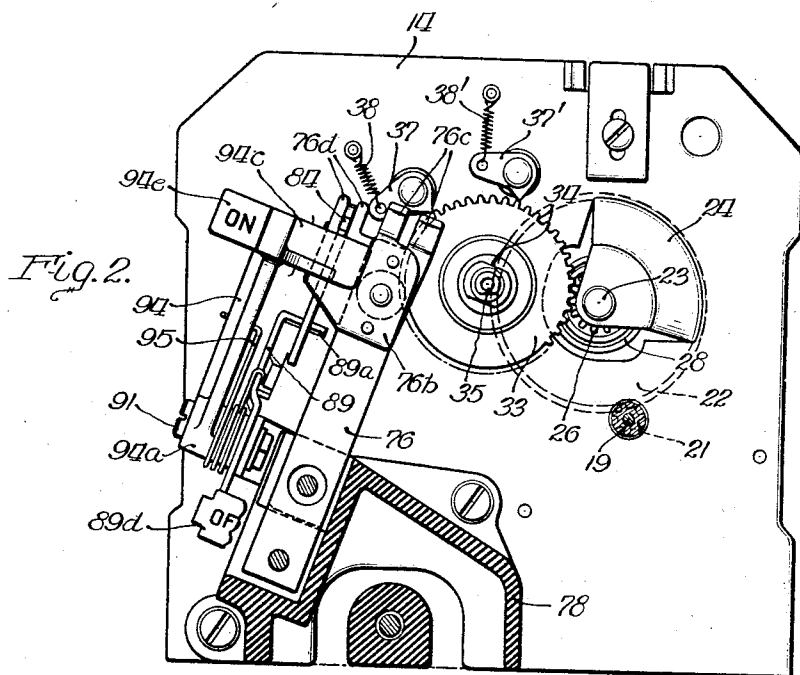
Nov. 30, 1943.

W. P. GALLAGHER
ADJUSTABLE TIME SWITCH

2,335,403

Filed Nov. 3, 1941

5 Sheets-Sheet 2



INVENTOR.
William P. Gallagher
BY
PROCESSES OF BOSTON, MASS.
Attys.

Nov. 30, 1943.

W. P. GALLAGHER
ADJUSTABLE TIME SWITCH

2,335,403

Filed Nov. 3, 1941

5 Sheets-Sheet 3

Fig. 6.

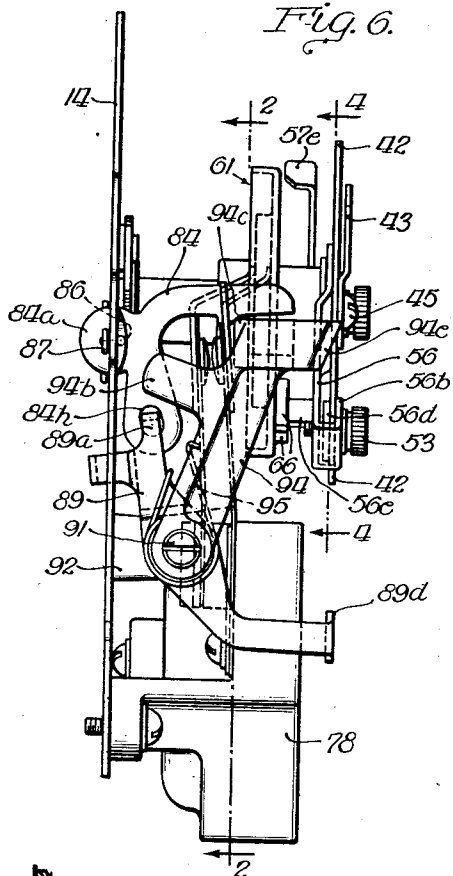


Fig. 7.

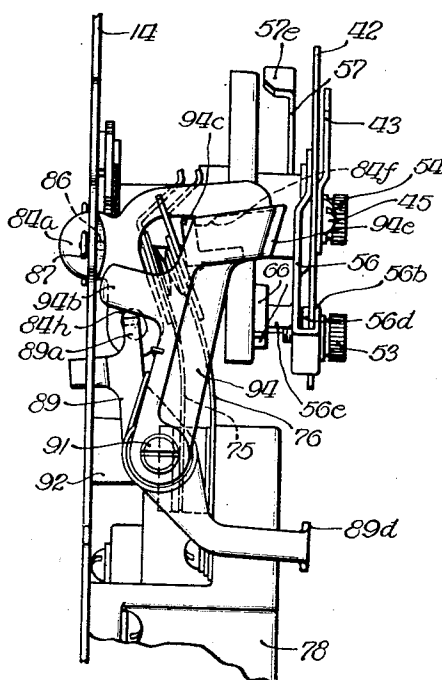


Fig. 8.

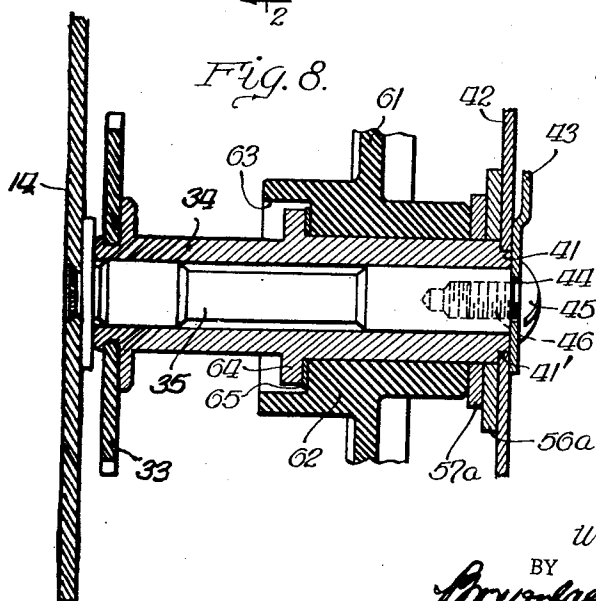
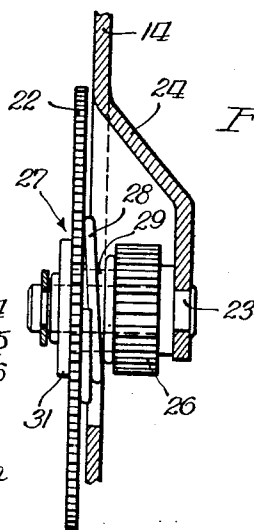


Fig. 9.



INVENTOR,
William P. Gallagher
BY
Morton B. Becker, Denver
Attys.

Nov. 30, 1943.

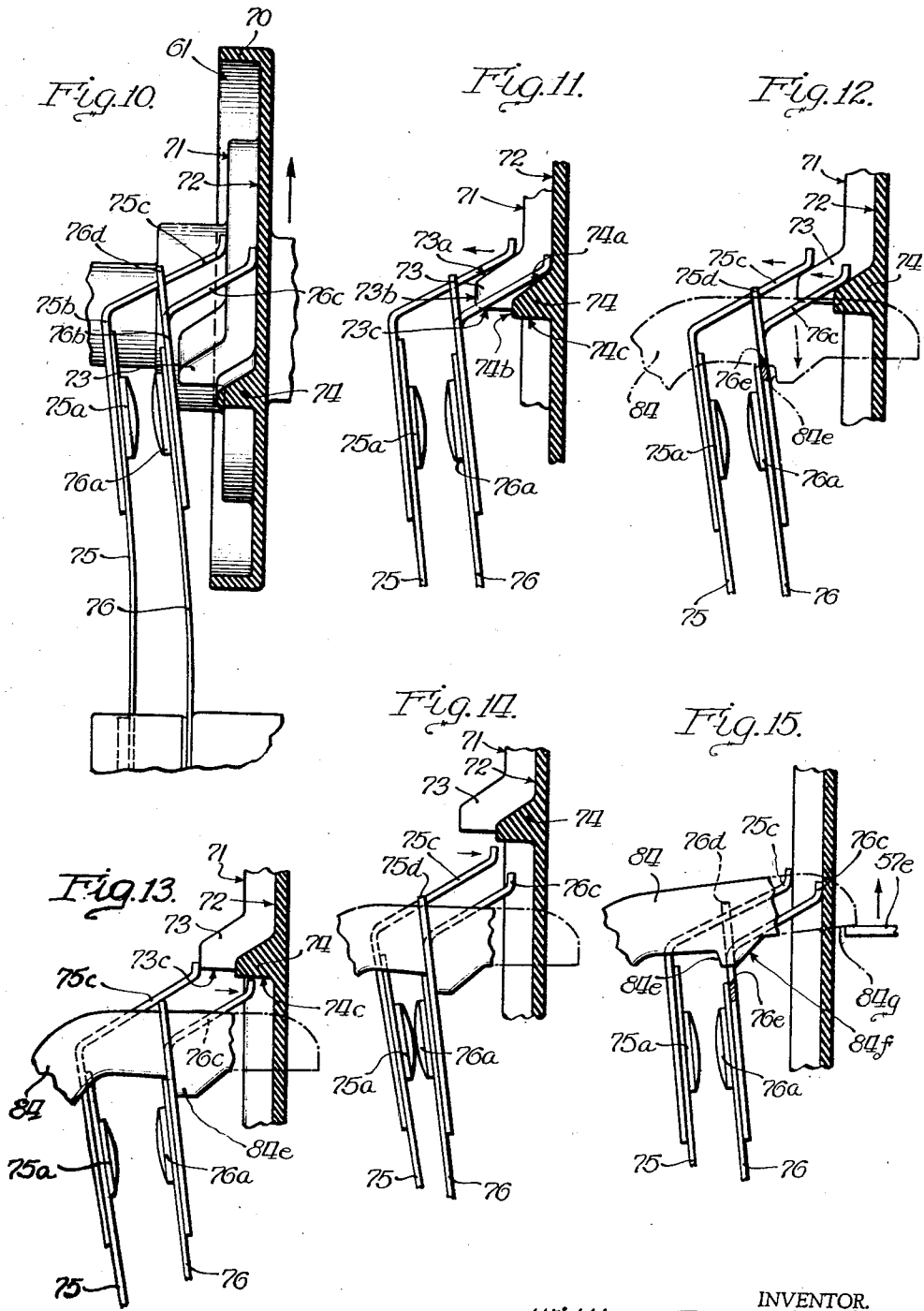
W. P. GALLAGHER

2,335,403

ADJUSTABLE TIME SWITCH

Filed Nov. 3, 1941

5 Sheets-Sheet 4



INVENTOR.
William P. Gallagher
BY *Morgan & Son, Boston & New York*
Attys.

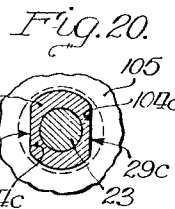
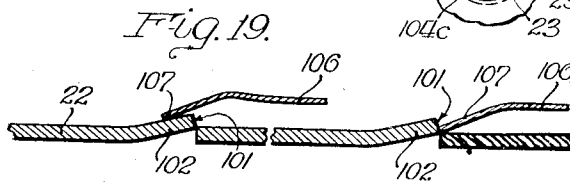
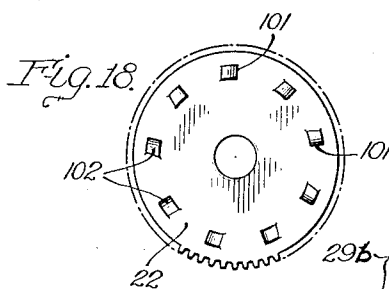
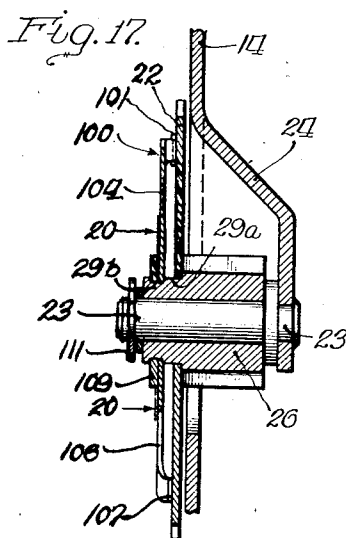
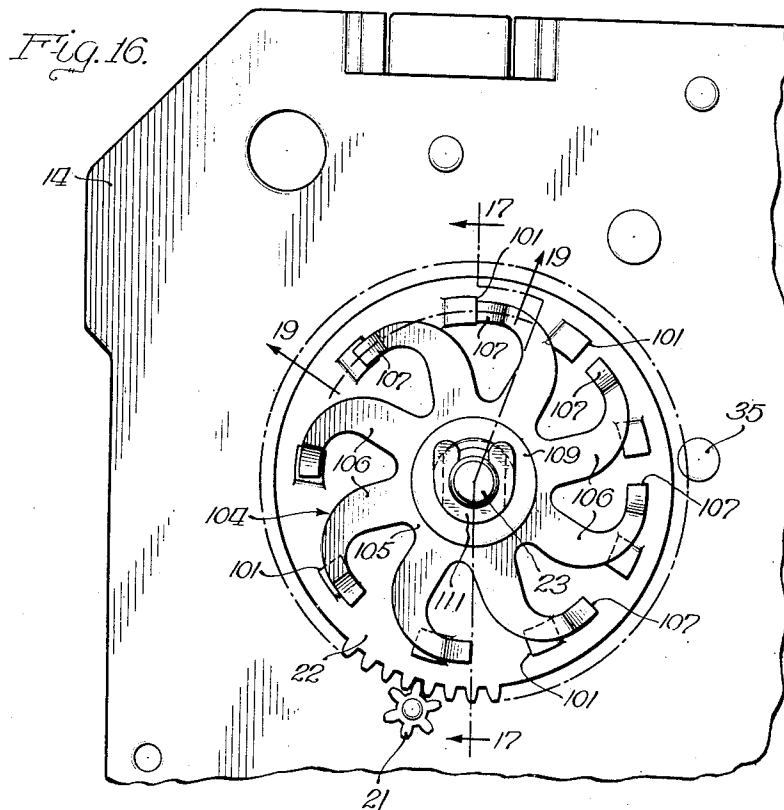
Nov. 30, 1943.

W. P. GALLAGHER
ADJUSTABLE TIME SWITCH

2,335,403

Filed Nov. 3, 1941

5 Sheets-Sheet 5



INVENTOR.
William P. Gallagher
BY
Brown, Jackson, Butler & O'Connell
Attys.

UNITED STATES PATENT OFFICE

2,335,403

ADJUSTABLE TIME SWITCH

William P. Gallagher, Chicago, Ill., assignor to
International Register Company, Chicago, Ill.,
a corporation of Illinois

Application November 3, 1941, Serial No. 417,614

23 Claims. (Cl. 200—38)

The present invention relates to time switches of the type which can be adjusted to open or close an electric circuit at any hour of the night or day. These time switches are extensively used for controlling electric signs, window lights, street lights and performing other circuit controlling functions predetermined to occur at different hours of the day or night.

One of the features of the invention is the provision of improved means for securing a quick break of the switch contacts.

Another feature of the invention is the provision of improved means for securing a quick make of the switch contacts.

Another feature of the invention resides in the simplicity and cheapness of manufacture of the switch. Other features, objects and advantages of the invention will appear from the following detail description of one preferred embodiment thereof. In the accompanying drawings illustrating such embodiment:

Figure 1 is a fragmentary front elevational view of my improved time switch, with the housing cover swung back to open position;

Figure 2 is a somewhat similar view taken on a rearwardly disposed section plane, approximately represented by the section plane 2—2 of Figure 6;

Figure 3 is an elevational view of the reverse side of the main mounting plate;

Figure 4 is an elevational view of the time adjusting apparatus, corresponding to a section taken on the plane of the line 4—4 of Figure 6 with the time driven dial removed;

Figure 5 is an elevational view of the reverse side of the cam disk;

Figure 6 is a side elevational view of the time switch, with the manually actuated switch opening and switch closing levers in their normal positions;

Figure 7 is a similar view with the manually actuated switch closing lever depressed to its switch closing position;

Figure 8 is an enlarged axial sectional view through the time driven sleeve, dial and cam disk;

Figure 9 is a detail view of the slippage clutch interposed between the electric motor and the time driven dial;

Figures 10 to 15, inclusive, are diagrammatic views showing the successive positions of the make and break contact springs in the automatic time cycle of the switch.

Figure 16 is a fragmentary elevational view somewhat similar to Figure 3, showing a modified

construction wherein a one-way drive clutch is interposed in the driving train;

Figure 17 is a transverse sectional view taken approximately on the plane of the line 17—17 of Figure 16;

Figure 18 is an elevational view illustrating the tongues punched outwardly from the drive gear to form drive shoulders;

Figure 19 is a developed sectional view taken along the curved section plane 19—19 of Figure 16; and

Figure 20 is a detail view of the keyed mounting of the resilient clutch spider.

The various parts of the time switch are preferably constructed and arranged for unit assembly on a mounting plate 14 which is preferably adapted for removable mounting in a suitable switch housing 15, or on any other desired support. The electric motor which drives the time switch is indicated at 16, this preferably being a conventional synchronous alternating current motor of the type commonly employed for driving electric clocks. Other time controlled or time driven mechanism can be employed in lieu of such electric motor. The motor unit 16 includes a gear reduction housing 17 enclosing suitable reduction gearing, this housing being secured by screws 18 to the mounting plate 14. A shaft 19 at the outer end of this reduction gearing mounts a small spur pinion 21 on the under or back side of the mounting plate 14. This pinion meshes with a large spur gear 22 which is part of a clutch assembly rotatably mounted on a stationary bearing stud 23. The outer end of this bearing stud 23 is rigidly staked in a raised supporting lug 24 which is punched upwardly from the body of the mounting plate 14. The large gear 22 is adapted to transmit a drive to a pinion 26 coaxial therewith through a friction slippage clutch 27. This friction clutch enables the time switch to be properly set without transmitting such setting motion to the electric motor 16. The clutch 27 comprises the spiral clutch spring 28 which has its large end bearing against one side of the large gear 22 and which has its small end bearing against the adjacent side of the pinion 26. The pinion 26 is formed with an elongated bearing hub 29 which is rotatably mounted on the stationary bearing stud 23, and the large gear 22 is mounted for rotation on this hub 29, see Figure 9. The spring 28 presses the large gear 22 against a gear retainer washer 31 also mounted on the hub 29, and the friction slippage occurs between the gear 22 and washer 31.

The pinion 26 transmits rotation to a large gear 33 disposed forwardly of the mounting plate 14, the gear ratio of the various gears in the train being such that the large gear 33 is revolved through one complete revolution every twenty-four hours. This large gear 33 is staked to the rear end of a drive sleeve 34 which is mounted for free rotation on a stationary center post 35. (See Figure 8.) The center post has its rear end rigidly anchored in the mounting plate 14. A pair of dogs 37, 37' are pivotally mounted on the base plate 14 (Figure 2) and are constantly urged into the teeth of the large gear 33 by tension springs 38, 38'. Both dogs face in the same direction, and their spacing is such that they are offset a half tooth of the gear 33, these dogs permitting free clockwise rotation (as viewed in Figure 2) in any timing adjustment of the gear and sleeve 33, 34 but positively preventing even a relatively small counterclockwise motion of these parts. Such counterclockwise motion might jam or break some of the switch parts, and hence the two dogs are provided to give double assurance against such motion and to prevent even a relatively small motion in such direction. The friction slippage clutch 27 is interposed in the driving train between the ratchet mechanism 33, 37, 38 and the electric motor 16 where it will permit adjusting rotation of the rotary member 34, independently of the electric motor, but without permitting backward rotation of the rotary member 34.

The forward end of the time driven sleeve 34 has a reduced portion 41 over which is mounted a time driven disk or dial plate 42 (Figure 8), the sleeve and disk being fixedly coupled together for conjoint rotation, as by forming polygonal or splayed surfaces 41' on the reduced portion 41 engaging within a correspondingly shaped opening in the dial 42. The dial 42 rotates directly with the gear 33, and hence makes one complete revolution every 24 hours. This timed relation is necessary in all situations where the complete cycle of the time switch extends over the 24 hour period of one night and one day, but this timed relation can, of course, be varied wherever the cycle is completed in either a shorter or longer interval. A fixed time designating pointer 43 is stationarily anchored to the front end of the center post 35, above the disk 42. A splayed or polygonal extremity 44 on the center post engages within a correspondingly shaped opening in the pointer 43, and a screw 45 extends down through the pointer and taps into a threaded bore 46 in the center post for stationarily mounting the pointer 43. The time driven disk 42 has inscribed on its upper surface the hour and fractional hour markings 48 designating the 12 hours of the day and the 12 hours of the night. These markings will move under the pointer 43, the particular hour of the day or night being indicated directly by the particular marking 48 in registration with the tip of the pointer 43. In setting the time switch into operation after installation, and in resetting the device after a current failure on the line, the disk 42 is merely revolved in the clockwise direction indicated by the arrow 49 to place the proper marking 48 at the tip of the pointer 43.

Clamped to the time driven disk 42 to rotate therewith are two time-settable members which predetermine the on and off times in the time switch cycle, one of these being indicated by the "on" clamping screw 53 and the other being indicated by the "off" clamping screw 54.

The "on" clamping screw 53 adjustably clamps a time-settable arm 56 to the disk 42, and the "off" clamping screw 54 adjustably clamps a time-settable arm 57 to the disk 42. The "on" arm 56 has a hub portion 56a at its inner end, and the "off" arm 57 has a hub portion 57a at its inner end, these two hub portions being supported for rotation on the front portion of the drive sleeve 34, below the disk 42. The outer end of the "on" arm 56 is formed with an upwardly and inwardly bent clamping flange 56b terminating in the index pointer 56c, and the outer end of the "off" arm 57 is formed with an upwardly and inwardly bent clamping flange 57b similarly terminating in an index pointer 57c. The threaded shanks of the two clamping screws 53 and 54 pass down freely through holes in their respective clamping flanges 56b and 57b and thread into clamping plates 56d and 57d respectively. These clamping plates engage the under side of the time driven disk 42, and enable each time-settable arm 56 and 57 to be adjustably clamped to any desired point around the circumference of this disk by the tightening of its respective clamping screw 53 or 54. A lug 56e is bent downwardly from the "on" arm 56 for establishing coupling connection with the cam disk 61 which I shall shortly describe. A lug 57e is also bent downwardly from an extension portion 57f projecting from the "off" arm 57, this latter lug 57e being adapted to trip a certain latch or pawl governing the "off" operation of the contacts, as I shall shortly describe.

The cam disk or timing rotor 61 is preferably constructed of insulating material, such as a moulded phenolic-condensation product, and comprises a hub 62 which is mounted so as to be capable of rotation on the forward end of the drive sleeve 34 (Figure 8). A counterbore 63 formed in the rear end of the hub 62 is adapted to fit over a flange 64 on the sleeve 34 for establishing the axial position of the cam disk on the drive sleeve, a suitable slip washer 65 being interposed between the upper end of the counterbore 63 and the flange 64. Projecting forwardly from the outer rim portion of the cam disk are lugs 66 defining a radial slot 67 therebetween. The lug 56e which is bent downwardly from the "on" timing arm 56 is adapted to fit into the slot 67, whereby the "on" timing arm 56 is coupled directly to the cam disk 61 so that any timing adjustments given the arm 56 are correspondingly transmitted to the cam disk. The cam disk, of course, rotates directly with the time driven indicating disk 42 through the medium of the clamping connection established by way of the clamping screw 53 and arm 56.

Formed in the rear side of the cam disk 61 are a peripheral flange 70 and two circular cam tracks located at different radii. The inner cam track for controlling the make contact spring is indicated at 71, and the outer cam track for controlling the break contact spring is indicated at 72, these two contact springs being hereinafter described. The two cam tracks lie at different levels, the outer track being recessed to a greater depth in the body of the cam disk so that it lies forwardly or above the inner cam track 71. Projecting from the inner track is a cam hump 73 having a forward slope 73a, a peak 73b and a drop-off rear edge 73c. Similarly, projecting from the outer track is a cam hump 74 having a forward slope

74a, a peak 74b and a drop-off rear shoulder 74c. For the particular relation of make and break contact blades to be hereinafter described, the cam peak 73b extends substantially beyond the level of the inner cam track 71, and the cam peak 74b extends substantially beyond the outer cam track 72, the two rear edges 73c and 74c preferably lying on a non-radial line, as clearly shown in Figure 5.

The timed circuit controlling function is performed by two switch blades 75 and 76 having cooperating contacts 75a and 76a adapted to move into and out of engagement. These two blades are preferably constructed in the form of relatively stiff phosphor bronze contact springs both adapted for flexing movement toward and away from each other. The stationary lower ends of these blades or springs are fixedly secured to an insulating terminal block 78 mounted on the lower portion of the mounting plate 14. Three connector terminals 79, 80 and 81 are anchored in recesses in this block. The rearward or lower contact blade 75 which makes circuit has electrical connection with the terminal connector 81, and the forward or upper contact blade 76 which breaks circuit has electrical connection with the terminal connector 79. The intermediate terminal connector 80 has electrical connection with one terminal of the electric motor 16, the other terminal of this motor being connected with terminal connector 79. The upper ends of the two switch blades extend into positions in rear of the cam disk 61 where they can cooperate with the cam tracks 71 and 72 formed on the back side of said disk.

Riveted to the upper end of the make contact blade 75 is a clip or plate 75b formed with a forwardly projecting finger or shoe portion 75c adapted to ride on the inner cam track 71 and inner cam hump 73. The break contact blade 76 has likewise riveted to its free end a clip or plate 76b from which projects a finger or shoe portion 76c adapted to ride upon the outer cam track 72 and outer cam hump 74. As shown in Figure 2, a portion of the clip 76b projects to one side and is formed with two upwardly extending guide fingers 76d for embracing the sides of a latching pawl 84. The guide slot between said fingers is formed with a latching shoulder 76e (Figure 15) at its inner end for engaging with the latch, as I shall presently describe. The two shoe portions 75c and 76c of the two contact blades ride on the tracks 71 and 72 and ride up on to the cam humps 73 and 74 during the "off" period of the switch when the contacts 75a and 76a of the blades are maintained separated. The "on" period of the switch occurs after the shoe portions have ridden up on the cam humps 73 and 74 and have snapped down off the drop-off shoulders 73c, 74c. At this time, the two blade elements 75 and 76 are prevented from snapping back into engagement with their respective tracks on the cam disk by the action of the aforesaid latch or pawl 84. The action of this latch is to hold the two contact blades in circuit closing engagement.

Referring to Figures 6 and 7, this latch or pawl 84 is of bellcrank formation and comprises a downwardly extending pivot lug 84a formed with front and rear pivot apertures therein. The pivot lug 84a extends rearwardly through a slot 85 (Figure 3) formed in the mounting plate 14, and a pivot pin 86 passes through the front pivot

aperture in front of said plate and a cotter pin 87 passes through the rear pivot aperture in rear of said plate, thereby forming a simple and inexpensive pivotal support for the latch on the mounting plate. The forwardly extending arm of the pawl 84 is disposed between the guide fingers 76d at the end of the break contact blade 76, these guide fingers guiding the oscillatory motion of the pawl. A shoulder 84e (Figure 15) projecting from this forwardly extending arm is adapted to latch over the latching shoulder 76e of the break contact blade 76 when the pawl 84 is oscillated downwardly toward the inner end of the guide slot formed between the fingers 76d. In this position of the parts (Figure 13), the pawl holds the break contact blade 76 latched rearwardly, whereby the make contact blade 75 is enabled to snap forwardly into circuit closing engagement with the break contact blade when said make contact blade 75 rides off its drop-off shoulder 73c. An inclined slope 84f leads down to the latching shoulder 84e on the latch 84 for cooperating with a manually actuated switch closing lever which I shall later describe. Formed on this forward arm of said latch 84 beyond the sloping surface 84f is a tripping edge or shoulder 84g which is adapted to be engaged by the tripping lug 57e which extends rearwardly from the "off" tripping arm 57. When the time driven lug 57e engages this tripping edge 84g it oscillates the pawl 84 upwardly and rearwardly, thereby withdrawing the latching shoulder 84e from the latching shoulder 76e of the break contact blade 76, and hence permitting both contact blades to snap forwardly into riding contact with their respective cam tracks 71 and 72. This separates the switch contacts 75a and 76a. The pawl 84 is composed of insulating material and hence establishes no electrical connection from the contact blade 76 to other parts of the structure. Referring again to Figures 6 and 7, the downwardly extending arm of said pawl is formed with an elongated opening 84h into which extends an actuating lug 89a projecting laterally from one end of an actuating lever 89. The lever is pivotally supported on a pivot stud 91 which has anchored mounting in the forward end of a lug 92 punched forwardly from the mounting plate 14. Projecting rearwardly from the upwardly extending arm of the lever 89 is a stop lug 89b which passes rearwardly through a slot 93 (Figure 3) in the mounting plate and which is formed with a laterally bent shoulder 89c adapted to engage the back side of the mounting plate 14 for limiting the clockwise rotation of the lever 89, as viewed in Figure 6. The forwardly extending arm of said lever is formed with a laterally bent finger piece 89d in which is stamped the word "off" for denoting that this finger piece 89d is to be depressed when it is desired to manually actuate the switch to its "off" position. The switch can also be manually actuated to the "on" position by depressing an "on" actuating switch lever 94. This latter lever is mounted on the same pivot pin or stud 91 on which the lever 89 is mounted, said "on" actuating lever being composed of insulating material. A coil spring 95 surrounds the hub 94a of the lever 94 and has one end hooked to bear rearwardly against the upwardly extending arm of lever 89 and its other end hooked to bear forwardly against the back side of lever 94. The tension of this spring tends to swing lever 89 in a counterclockwise direction and to swing lever 94 in a clockwise

direction, as viewed in Figures 6 and 7. A stop lug 94b projects rearwardly from the lever 94 in position to strike the mounting plate 14 for limiting the counterclockwise motion of lever 94. An actuating lug 94c (Figures 2 and 7) projects laterally from the swinging end of the lever 94, extending inwardly across the forward surface of the front contact spring 76 and its clip plate 76b. This actuating lug lies under or in back of the aforementioned peripheral flange 70 which projects rearwardly from the cam disk 61, the lug normally bearing against said flange. A laterally projecting finger piece 94e is formed at the end of lever 94, and has the inscription "on" embossed therein to indicate that this finger piece is to be depressed when it is desired to manually actuate the switch to the "on" or closed circuit position. As shown in Figure 6, the actuating lug 94c is in a position to engage the sloping shoulder 84f of pawl 84 when the "on" actuating lever 94 is thus depressed, whereby the pawl is then swung to its unlatched position. Figure 6 illustrates the normal position of the "on" actuating lever 94 and its associated "off" release lever 89, and Figure 7 illustrates the position of the parts after the "on" actuating lever 94 has been depressed to its switch closing position. In this normal position of the "on" lever 94 shown in Figure 6, the lug extension 94c is disposed out of contact with the break contact spring 76 and latching pawl 84, this lug extension normally bearing against the peripheral flange 70 of the cam disk under the pressure of the spring 94. It is only when the "on" lever 94 is manually depressed through the finger piece 94e that the lug extension 94c is swung inwardly against the break contact blade 76 and against the latching pawl 84. In such manual actuation of the "on" lever 94, the switch blade 76 is flexed back to circuit closing position and the edge of lug 94c snaps in under the latching shoulder 84e of latch 84. This latches the switch in circuit closing position, as shown in Figure 7, in which position it will remain until it is either manually released by depressing the finger piece 89d of the "off" actuating lever 89, or until it is automatically released by the time driven tripping lug 57e engaging the latch 84 and releasing said latch from the "on" lever 94, thereby permitting said lever 94 to return to the normal position shown in Figure 6.

The sequence of steps occurring in the automatic timed operation of the switch is illustrated in Figures 10 to 15 inclusive. In the normal open circuit position of the switch, shown in Figure 10, the rider fingers or shoes 75c and 76c are riding on the flat track surfaces 71 and 72 of the continuously rotating cam disk 61. As the set time approaches for the closing of the switch, the cam humps 73 and 74 ride in under the shoes 75c and 76c, thereby flexing the two contact springs rearwardly from their normal positions. Figure 11 shows the start of this rearward flexing operation, and Figure 12 shows a further point in the operation. It will be noted that the two blades move back together, in substantial parallelism, so that their contacts 75a, 76a remain in spaced, open circuit relation. When the blades have been flexed approximately to the positions shown in Figure 12, the latch 84 is free to swing down to the holding position shown in this figure, with the latch shoulder 84e in position to engage the shoulder 76e on the blade 76. Referring to Figure 13, the timing of the drop-off shoulder 74c is preferably slight-

ly in advance of the timing of the drop-off shoulder 73c, and hence the break contact spring 76 is dropped back a slight distance against the shoulder 84e of latch 84 before the make contact spring rides off the drop-off shoulder 73c. However, this occurs a very short time later, as shown in Figure 14. It will be seen that in such position of the parts, the break contact spring 76 stands latched in a rearwardly flexed position, and when the make contact spring 75 rides off the drop-off shoulder 73c it snaps its contact 75a forwardly into circuit closing engagement with the companion contact 76a on the break spring 76. This closing of the switch contacts occurs with an instantaneous snap motion, because the break spring 76 is fixedly latched in its rearward position, and the make spring 75 has an instantaneous forward motion in snapping off the drop-off shoulder 73c. Hence, there is no arcing or pitting in the closing of the switch contacts.

The switch remains closed for the set time as predetermined by the angular setting of the tripping arm 57e relatively to the time driven disk 42. When the tripping arm 57e arrives at the switch tripping point it engages the shoulder 84g on the front edge of the latch 84. Thereupon, the latch is slowly swung with the continued motion of the tripping arm until the latch shoulder 84e releases the holding shoulder 76e on the blade 76. Figure 15 shows the position of the parts after this releasing operation has occurred. It will be evident that both spring blades 75 and 76 will snap back to their normal positions, with the shoe 75c riding on the inner track 71 and with the shoe 76c riding on the outer track 72, corresponding to the positions of the blades shown in Figure 10. The shoes and tracks are proportioned to effect a differential stopping of the motion of the blades, to effect a snap separation of the contacts 75a, 76a. This is obtained by having the shoe 75c strike its trackway 71 first, and having the shoe 76c strike its trackway 72 later. The brief continued motion of the break spring 76 after the inward motion of the make spring 75 has been stopped, results in an extremely quick separation of the contacts, so that there is a minimum tendency for arcing and pitting of the contacts. The continued motion of the tripping arm 57e carries it past the end of the latch shoulder 84g, and thereupon the latch snaps back to its normal position. All of the parts of the switch are now back in their normal positions, with the switch open, ready for a repetition of the same closing and opening cycle at the same time the next day or evening, or at such other predetermined time as may have been set on the device.

It will be understood that whenever it is desired to adjust the switch closing time, this is accomplished by merely loosening the "on" clamping screw 53 and then swinging the pointer 56c to the other desired time indicated by the markings 48 on the time driven dial 42. This adjustment serves to shift the angular position of the cam disk 61 and its cam humps 71 and 72 either forwardly or backwardly relatively to the time driven dial 42 for advancing or retarding the switch closing time, as the case may be. Similarly, whenever it is desired to adjust the switch opening time, this is accomplished by merely loosening the "off" clamping screw 54 and then swinging the pointer 57c to the other desired time indicated by the markings 48 on

the time driven dial 42. This adjustment serves to shift the angular position of the tripping arm 37e either forwardly or backwardly relatively to the time driven dial 42 for advancing or retarding the switch opening time, as the case may be.

In the preceding description of the manually actuated switch opening lever 88 and of the manually actuated switch closing lever 94, I have shown how the operation of these levers is effective to manually operate the switch at any time. The switch can be closed manually and opened manually, independently of the time driven automatic mechanism. Furthermore, if the switch has been closed automatically it can be opened manually; and if it has been opened automatically it can be closed manually.

In Figures 16 to 20, inclusive, I have illustrated a modified construction in which an improved form of one-way drive clutch has been substituted for the friction slippage clutch 27 and the one-way pawls 37, 37'. In this modified construction, the same gear 22 which constituted the driving element of the slippage clutch 27 also constitutes the driving element of this improved one-way drive clutch, designated 100 in its entirety. In the modified form, the driving gear 22 is formed with an annular series of driving shoulders 101 projecting rearwardly from the body of the gear. As shown in Figure 19, these shoulders are preferably formed by punching tongues 102 rearwardly from the body of the gear, the free ends of the tongues facing in the normal, clockwise direction of rotation of the driving gear 22.

The driven element of the one-way drive device is in the form of a spider 104 comprising a hub portion 105 from which radiates a plurality of evenly spaced spring arms 106. These spring arms are preferably curved in the approximate S-formation shown so as to be of longer length for increased resiliency. The central portion of the spider is spaced slightly from the drive gear 22, but the tip ends of the spider arms are sloped forwardly, as indicated at 107, so as to bear constantly against the surface of the gear and to be engaged by the driving shoulders 101.

This one-way clutch 100 is mounted very similarly to the friction slippage clutch 27. The pinion 26 is formed with an integral bearing extension or hub 29a, and this gear and hub unit is rotatably mounted on the stationary bearing stud 23, substantially as previously described. The drive gear 22 is mounted on the bearing hub 29a so as to be capable of free rotation thereon. The spider 104 is mounted on a still smaller extension 29b of the bearing hub 29a, the shoulder at the inner end of such outer extension maintaining the hub of the spider spaced away from the surface of the drive gear 22, as previously described. Splayed or other like driving surfaces 29c on the outer bearing extension 29b engage corresponding driving surfaces 104c formed in the hub of the spider 104. A retaining washer 109 fits against the outer side of the spider, and the end of the bearing extension 29b is peened over the outer side of this retaining washer.

It will be apparent that the small spur pinion 21 driven by the electric motor 16 will impart a continuous, time driven rotation to the large driving gear 22 at all times. In Figure 16, this direction of rotation is clockwise, such rotation operating through the gears 26 and 33 to impart clockwise rotation to the time driven dial 42, as this dial is viewed from the front of the switch. In this clockwise rotation of the driving gear 22, 75

the driving shoulders 101 transmit the driving torque to the tip ends 107 of the spider 104. This establishes a one-way driving relation wherein the gear 22 positively drives the spider 104 in a clockwise direction, while still enabling the spider to be advanced in a forward or clockwise direction relatively to the gear, while not permitting the spider to be rotated backwardly relatively to the gear.

There are preferably a relatively large number of driving shoulders 101 and a relatively large number of driven shoulders 107, and the number of shoulders in one series is in prime relation to the number of shoulders in the other series. For example, in the preferred construction shown, there are nine driving shoulders 101 and eight driven shoulders 107, these two numbers being in prime relation to each other. By virtue of this prime relation, wherein one number of shoulders cannot be divided evenly into the other number of shoulders, only one driving shoulder and one driven shoulder will be engaging at any particular time. Upon a very small advancing movement of the spider relatively to the drive gear, this drive relation is immediately transferred to another drive shoulder and driven shoulder (the next in rearward sequence). The very small amount of angular movement that the spider has, relatively to the drive gear, before the drive relation is transferred back to the next driving shoulder and driven shoulder, prevents the possibility of the time driven dial 42 being rotated any appreciable amount in a counterclockwise direction. That is to say, all adjustments of the time driven dial 42 are thereby compelled to occur in a clockwise direction of rotation so that there is no possibility of the cam humps 73 and 74 on the cam disc 72 bending or damaging the contact springs. The gear reduction from the armature of the electric motor to the pinion 21 is of such design or of such magnitude that the motor cannot be driven in the reverse direction by any manual force capable of being exerted on the time driven dial 42.

While I have illustrated what I regard to be the preferred embodiments of my invention nevertheless it will be understood that such are merely exemplary and that numerous modifications and rearrangements may be made therein without departing from the essence of the invention.

I claim:

1. In an adjustable time switch, the combination of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for tripping said latch to effect snap separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, and adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch.

2. In an adjustable time switch, the combina-

tion of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts adapted to control an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly, a latch adapted to hold one of said contact springs in an outwardly flexed position, means on said cam disk for thereafter permitting the other contact spring to move into engagement with the contact spring held by said latch, a tripping device driven by said time driven member for tripping said latch to effect separation of said contact springs, and adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch.

3. In an adjustable time switch, the combination of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts adapted to control an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly, a latch adapted to hold one of said contact springs in an outwardly flexed position, means on said cam disk for thereafter permitting the other contact spring to move into engagement with the contact spring which is being held by said latch, a tripping device driven by said time driven member for tripping said latch to effect separation of said contact springs, and adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch.

4. In an adjustable time switch, the combination of a time driven rotary member, a break contact spring and make contact spring having cooperating contacts adapted to control an electric circuit, a cam disk driven by said time driven member, first and second cams on said cam disk for flexing said break contact spring and said make contact spring outwardly in spaced relation, a latch for holding said break contact spring in an outwardly flexed position, a drop-off shoulder on said first cam for permitting said break contact spring to drop back into engagement with said latch, a drop-off shoulder on said second cam for thereafter permitting said make contact spring to drop back into snap engagement with said break contact spring to close the switch, a tripping device driven by said time driven member for tripping said latch to effect separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, and adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch.

5. In an adjustable time switch, the combination of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for

tripping said latch to permit return motion of said contact springs, track means on said cam disk for interrupting the return motion of one of said contact springs in advance of the other contact spring so as to effect snap separation of said contact spring, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, and adjusting means for adjusting the angular position of said tripping device relatively to said time driven rotary member to vary the time of opening of the switch.

6. In an adjustable time switch, the combination of a time driven rotary member, a break contact spring and a make contact spring having cooperating contacts adapted to control an electric circuit, a cam disk driven by said time driven member, first and second cams on said cam disk for flexing said break contact spring and said make contact spring outwardly in spaced relation, a latch for holding said break contact spring in an outwardly flexed position, a drop-off shoulder on said first cam for permitting said break contact spring to drop back into engagement with said latch, a drop-off shoulder on said second cam for thereafter permitting said make contact spring to drop back into snap engagement with said break contact spring to close the switch, a tripping device driven by said time driven member for tripping said latch to permit return motion of said contact spring, first and second tracks on said cam disk adapted to be engaged by said break contact spring and by said make contact spring respectively, said second track being constructed to interrupt the return motion of said make contact spring in advance of the first track interrupting the return motion of said break contact spring, whereby to effect snap separation of the contacts on said springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, and adjusting means for adjusting the angular position of said tripping device relatively to said time driven rotary member to vary the time of opening of the switch.

7. In an adjustable time switch, the combination of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, and means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for tripping said latch to effect snap separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch, and manually actuated switch closing means for causing engagement of said contacts independently of said time driven rotary member.

8. In an adjustable time switch, the combination of a time driven rotary member, a make

contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for tripping said latch to effect snap separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch, and manually actuated switch opening means for causing separation of said contacts independently of said time driven tripping device.

9. In an adjustable time switch, the combination of a time driven rotary member, a make contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for tripping said latch to effect snap separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, adjusting means for adjusting the angular position of said tripping device relatively to said time driven member to vary the time of opening of the switch, manually actuated switch closing means for causing engagement of said contacts independently of said cam disk, and manually actuated switch opening means for causing separation of said contacts independently of said tripping device.

10. In an adjustable time switch, the combination of a rotary member adapted to be driven by driving means at a timed rate, a friction slip-page clutch in the driving train between said driving means and said rotary member, a make contact spring and a break contact spring having cooperating contacts for controlling an electric circuit, a cam disk driven by said time driven member, means on said cam disk for flexing both of said contact springs outwardly in separated relation, a latch adapted to latch said break contact spring substantially in said outwardly flexed position, means on said cam disk for thereafter permitting the make contact spring to snap into quick engagement with the break contact spring while the latter is held by said latch, a tripping device driven by said time driven member for tripping said latch to effect snap separation of said contact springs, adjusting means for adjusting the angular position of said cam disk relatively to said time driven rotary member to vary the time of closing of the switch, and adjusting means for adjusting the angular

position of said tripping device relatively to said time driven member to vary the time of opening of the switch.

11. In combination, a switch, a rotary member driven at a timed rate, cam means driven by said rotary member for controlling said switch, a latch cooperating with said cam means for producing a snap closing of said switch, tripping means driven by said rotary member for tripping said latch, and means for adjusting said cam means and said tripping means relatively to said rotary member.

12. In combination, an electric switch comprising relatively movable switch members, a time driven rotary member adapted to open and close said switch at preselected times, cam means driven by said rotary member for actuating said switch members to one position, latch means for holding one of said switch members substantially in said latter position prior to the closing of said switch, tripping means driven by said rotary member for tripping said latch means, and means for adjusting said cam means and said tripping means relatively to said rotary member for adjusting the closing and opening times of said switch.

13. In combination, an electric switch comprising relatively movable switch members, a time driven rotary member adapted to open and close said switch at preselected times, actuating means driven by said rotary member for actuating said switch members from a first position to a second position, latch means for holding one of said switch members substantially in said second position prior to the closing of said switch, means coacting with said actuating means for thereafter permitting the other of said switch members to move back toward said first position and thereby close said switch, tripping means driven by said rotary member for tripping said latch means, and adjusting means for adjusting said actuating means and said tripping means relatively to said rotary member.

14. In combination, an electric switch comprising relatively movable switch members, automatic mechanism adapted to open and close said switch at preselected times comprising a time driven rotary member, actuating means driven by said rotary member for actuating said switch members from a first position to a second position, latch means movable into a holding position for holding one of said switch members substantially in said second position, means coacting with said actuating means for thereupon permitting the other of said switch members to move back toward said first position and into engagement with the switch member held by said latch means, tripping means driven by said rotary member for thereafter tripping said latch means, and manually actuated means for operating said latch means into said holding position and out of said holding position independently of said automatic mechanism.

15. In combination, an electric switch comprising relatively movable switch blades having cooperating contacts, automatic mechanism adapted to open and close said switch at preselected times comprising a time driven rotary member, shifting means driven by said rotary member for shifting said switch blades from a normal position to a displaced position, holding means for holding one of said switch blades in said displaced position prior to the closing of said switch, release means for thereafter permitting the other switch blade to move back toward said normal position for effecting switch closing contact with the switch blade being held by said holding means, tripping means driven by said time driven rotary member

for thereafter tripping said holding means, means for adjusting said shifting means and said tripping means angularly relatively to said time driven rotary member for adjusting the times at which said switch is operated, and manually actuated mechanism for operating said switch independently of said automatic mechanism.

16. In combination, an electric switch comprising relatively movable switch members having cooperating contacts, a time driven rotary member including a time indicating dial, actuating means driven by said rotary member and adapted to move said switch to an actuated position, holding means for holding one of said switch members in said actuated position prior to the closing of said switch, tripping means driven by said rotary member for releasing said holding means, adjustable clamping means for adjustably clamping said actuating means to said rotary member in different angular positions, and adjustable clamping means for adjustably clamping said tripping means to said rotary member in different angular positions.

17. In an adjustable time switch, the combination of driving means adapted to rotate at a timed rate, a time driven rotary member, a driving train connecting said driving means with said rotary member, a friction slippage clutch interposed in said driving train for permitting adjusting rotation of said rotary member independently of said driving means, ratchet mechanism separate from said friction slippage clutch and interposed in said driving train between said slippage clutch and said rotary member for positively limiting the adjusting rotation of said rotary member to motion in one direction, an electric switch comprising a pair of relatively movable switch members having cooperating contacts, actuating means driven by said rotary member and adapted to move said switch to an actuated position, holding means for holding one of said switch members in said actuated position, and tripping means driven by said rotary member for releasing said holding means.

18. In combination, an electric switch comprising relatively movable switch blades, a time driven rotary member, cam means driven by said rotary member operative to deflect said switch blades to an actuated position, a manually actuated member operative to deflect said switch blades to an actuated position, a latch operative to hold one of said switch blades in the actuated position to which it has been moved by said cam means, and also operative to hold said manually actuated member in its actuated position, tripping means driven by said rotary member operative to release said latch, and a second manually actuated member operative to release said latch.

19. In an electric time switch, the combination of a time driven rotary member, a switch

comprising cooperating switch members, means responsive to said rotary member for actuating said switch to one position at a predetermined time, holding means for holding one of said switch members in one position prior to and after the closing of said switch, and means responsive to said rotary member for releasing said holding means at a predetermined time.

20. In an electric time switch, the combination of a rotary member adapted to be driven by driving means at a timed rate, a driving train connecting said driving means with said rotary member, switch means responsive to said rotary member, a friction slippage clutch interposed in said driving train for permitting adjusting rotation of said time driven rotary member independently of said driving means, and ratchet mechanism separate from said friction slippage clutch and interposed in said driving train between said time driven rotary member and said slippage clutch for positively confining the adjusting rotation of said rotary member to motion in one direction.

21. In a time switch, the combination of a time driven member, a switch comprising a pair of relatively movable contact springs bearing cooperating contacts, actuating means responsive to said time driven member for actuating said contact springs to one position and causing a quick drop-off action in such actuation, holding means for holding one of said contact springs and cooperating with said quick drop-off action to produce a snap closing of said contact springs, and means responsive to said time driven member for releasing said holding means.

22. In a device of the class described, the combination of an electric switch comprising a pair of relatively movable contact springs bearing cooperating contacts, time driven cam means for causing a quick drop-off action of said contact springs, latch means cooperating with the quick drop-off action of said cam means to produce a snap closing of said contact springs at a predetermined time, and time driven tripping means for tripping said latch means to produce a snap opening of said contact springs at a predetermined time.

23. In a device of the class described, the combination of a switch comprising a pair of relatively movable contact springs bearing cooperating contacts, time driven cam means adapted to displace said contact springs outwardly from their normal positions, drop-off shoulder means associated with said cam means for thereafter permitting said contact springs to snap back towards their normal positions, holding means for temporarily preventing one of said contact springs from returning to its normal position, and time driven means for tripping said holding means.

WILLIAM P. GALLAGHER.