March 29, 1932. C. I. HALL 1,851,247

TRAFFIC SIGNAL CONTROLLER

Filed Feb. 12, 1929 2 Sheets-Sheet 1

Fig. 1.

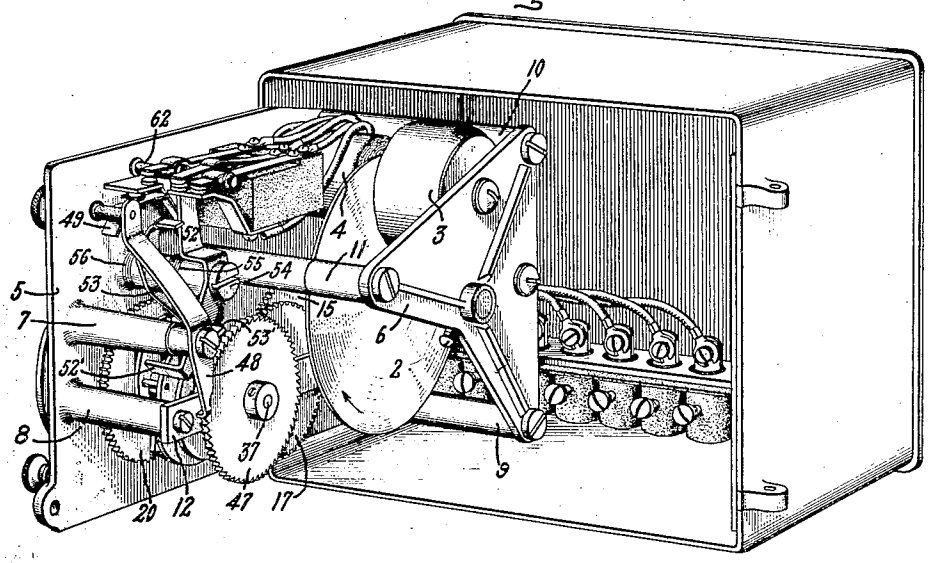

Fig. 2.

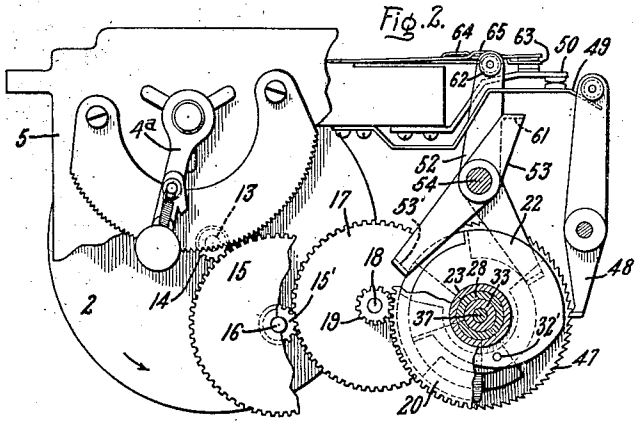

Fig. 3.

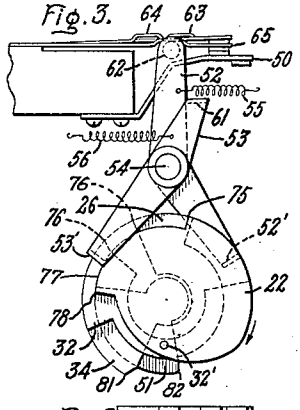

Fig. 4.

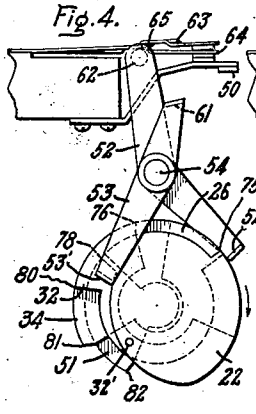

Fig. 5.

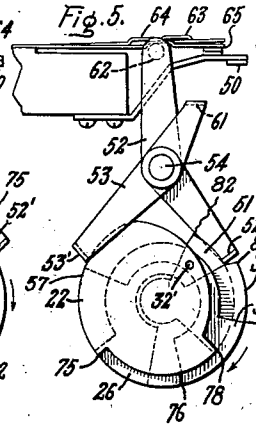

Fig. 6.

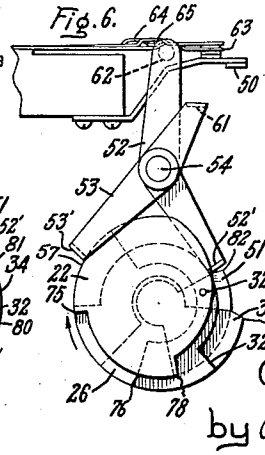

Fig. 7.

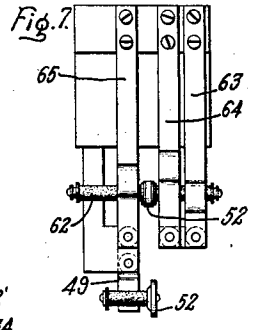

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Fig. 8.

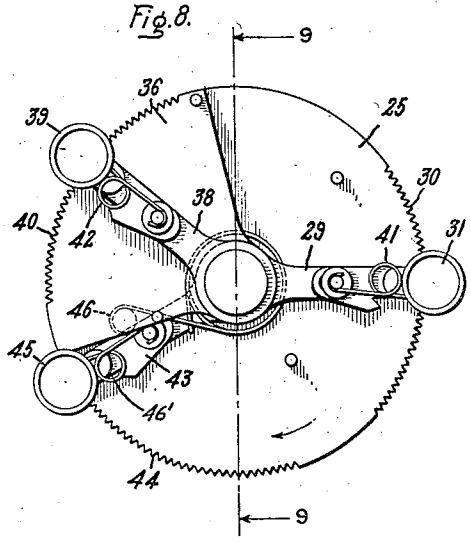


Fig. 9.

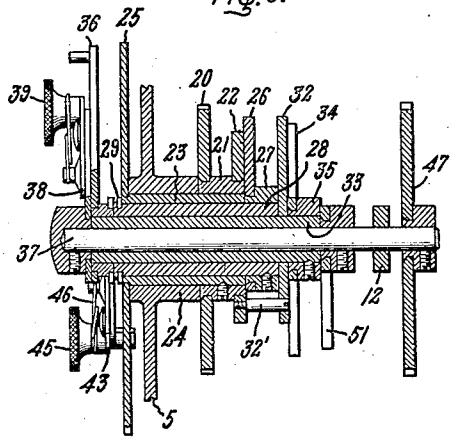


Fig. 10.

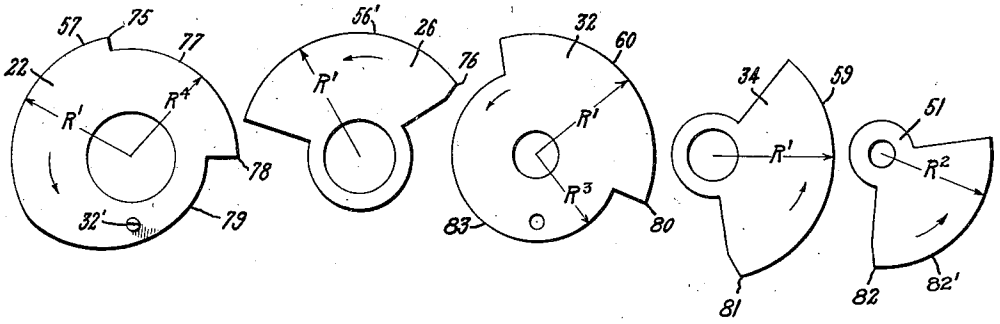
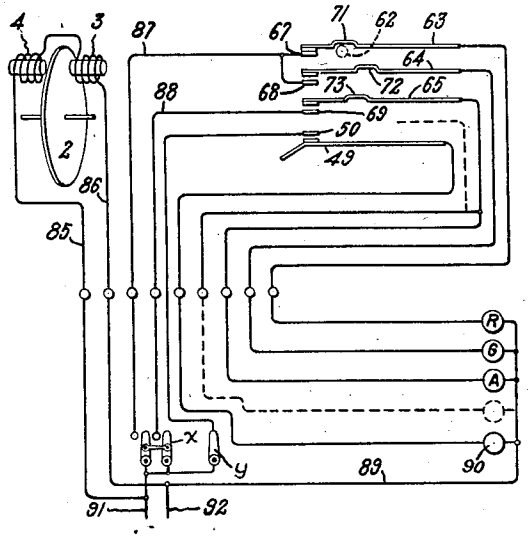


Fig. 11.



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Patented Mar. 29, 1932

1,851,247

UNITED STATES PATENT OFFICE

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TRAFFIC SIGNAL CONTROLLER

Application filed February 12, 1929. Serial No. 339,349.

My invention relates to circuit controllers. More particularly it relates to circuit controllers of the type especially adapted for use in connection with the operation of traffic signals.

In regulating traffic along a thoroughfare across which extend other avenues of traffic or cross roads, it is desirable that the time interval during which the traffic is allowed to proceed along the main thoroughfare and along the cross roads be changed from time to time. In connection with such traffic signals it is not only customary to have "stop" signals and "go" signals, but it is also common to have "change" signals.

It is an object of my invention to provide a circuit controller the mechanism of which is adapted to be enclosed in a suitable container, which mechanism comprises timing means for operating "go", "stop", and "change" signals for both the main highway and the cross roads and by means of which the ratio of the go and stop signals may be varied, as well as the length of the "change" signal in either direction. It is also an object of the invention to provide suitable dials in order that a traffic officer may readily and effectively change the timing of all of said signals to suit the traffic conditions at any particular time without having to open up the casing.

The invention will be more readily understood from the following specification and claims, reference being had to the accompanying drawings in which Fig. 1 is a perspective view of a circuit controller involving the features of the invention. In this figure the mechanism is shown mounted in a box container, the door of which has been removed. In this figure the mechanism, which is mounted on a hinged frame, is shown swung outward, showing the back of the frame, upon which are mounted the motor, the circuit closing contacts, the gear mechanism and the circuit controlling cams.

Fig. 2 shows the mechanism with the front part of the frame removed showing the motor, the gears, the cams, and the circuit closing contacts. In this figure the mechanism is shown in front elevation. Fig. 3 shows the portion of the mechanism which comprises the contact operating arm and the controlling cams. The controlling arm is shown in one position and the circuit closing contacts are shown in the corresponding position. Fig. 4 is a similar view of the same portion of the apparatus showing the arm in a different position. Figs. 5 and 6 are similar views of the same portion of the apparatus showing the arm in still different positions. Fig. 7 is a top view of the circuit closing contacts. Fig. 8 shows in elevation the dials and levers or arms in the front of the box through the medium of which the cams of the device are properly set for the timing desired. Fig. 9 is a side view in section of the device taken on line 9—9, Fig. 8. Fig. 10 shows the cams of Fig. 9 in so-called exploded view and in elevation. In this figure the cams are represented in one of a number of relative positions along a common axis in which they may be adjusted. Fig. 11 is a schematic diagram showing the circuits controlled by the device and a set of signals for a street intersection. In this figure the circuit over which the operating motor is energized is also shown.

Referring to Fig. 1 of the drawings, the motor for driving the device comprises a disk armature 2 and a pair of coils 3 and 4. The motor is provided with suitable shading coils which may be adjusted by lever arm 4ª for varying the speed of the motor. The motor, together with the rest of the mechanism is mounted on a suitable frame having a front plate 5, a rear plate 6, and a number of posts 7, 8, 9, 10 and 11, as well as a cross bar frame element 12.

Fig. 2 shows the relation of the gears that are interposed between the motor and the cam mechanism driven thereby. It will be seen that the motor shaft 13 carries a pinion 14 which meshes with gear 15. This latter is mounted on the shaft 16 which carries a pinion 15′ which engages with gear 17 mounted on shaft 18 with pinion 19. Pinion 19 in turn engages the gear 20 which gear, as shown in Fig. 9, is mounted on a collar 21. On the same collar Fig. 9 there is mounted a cam 22. Within the collar 21 there is a tubular bear-

ing 23, to which the collar 21 is secured. This tube passes through the bearing 24 in the front part 5 of the frame, which tube terminates in a dial 25. Next to the cam 22 there is a second cam 26 which is secured to the collar 27, which collar is in turn secured to the tube 28 located within the tube 23. Beyond the frame 5 and beyond the dial 25 this tube 28 has secured to it an index arm or lever arm 29. This lever is provided with a radially movable dog element 31, under the control of spring 41, which engages the teeth 30 on the peripheral section of the dial 25 and which is provided, for convenience, with a knob as shown. Therefore, by unlatching the arm 29 from the teeth and rotating it the cam 26 may be adjusted with respect to the cam 22.

Behind the cam 26 there is a third cam 32, which is loosely mounted on a hollow tube element 33. This cam is secured to the cam 22 by means of a bolt 32'. Obviously, therefore, the two cams 22 and 32 are rigidly connected together. Consequently, when the gear 20 is rotated both cams 22 and 32 must rotate with it. Just beyond the cam 32 there is a fourth cam 34 which is secured to the collar 35, which collar is in turn secured to the tube 33. This tube terminates in a dial segment element 36. Within the tube 33 there is a shaft 37 to which there is secured an index arm or lever 38. This lever is provided with a dog 39 similar to dog 31. This dog 39 normally engages the teeth 40 on the periphery of the segment 36 due to the tension of coiled spring 42. Between the segment 36 and the lever 29 there is loosely mounted another index arm or lever 43 provided with a dog 45 similar to dogs 31 and 39 which normally is held in engagement with the teeth 44 on the peripheral section of the dial 25 by means of the coiled spring 46'. The dial segment 36 and the arm 43 are connected by a coiled spring 46, one end of which is secured to the segment and the other end of which is secured to the arm 43 tending normally to draw the segment 36 against the arm 43. The object of this spring is to enable the arm 38 to be set or adjusted at any instant regardless of the position of the cams which, at intervals during a cycle of operation lock the segment 36 against counter-clockwise rotation. However, at any other time the spring 46 will draw the segment into the new position determined by the arm 43.

It will be seen that the shaft 37, Fig. 9, passes through the frame member 12 at the right and has secured to its inner terminal a gear 47 which serves to control a lever 48 (see Fig. 1) which latter, in turn, controls the contact spring 49 associated with the circuit contact 50 (see Fig. 11). When this gear is rotated the arm oscillates and causes the contacts 49 and 50 to make and break regularly for controlling a flash signal when the regular green, red and amber signals usually employed are not in service. The shaft 37 furthermore carries a cam 51 secured to the shaft at a point between the cam 34 and the frame support 12, Fig. 9.

With the mechanism described when the gear 20 is rotated by the motor the whole mechanism shown in Fig. 9 rotates about the bearing 24 inasmuch as all of the elements are interlocked by means of the levers 29, 38 and 43, and their dogs. However, the cam 26 is adjustable with respect to the cam 22 through the medium of the lever 29. Similarly the cam 51 is adjustable with respect to both cams 34 and 32 through the medium of the lever 38. Furthermore, both cams 34 and 51 are adjustable simultaneously with respect to the cam 32 through the medium of the lever 43, inasmuch as the lever 38 locks cams 34 and 51 together.

One relation of cams 22, 26, 32, 34 and 51 with respect to each other along the axis of the shaft 37 is indicated in Fig. 10. The relation of these cams to the arm 52 is indicated in Figs. 2 through 7. It will be seen that the arm 52 is under the control of the arm 53, both of which arms are pivoted in common about the pin 54, which is secured to the frame 5 (see Fig. 1). Referring to the same figures, 2 through 7, the arm 52 is provided with a spring 55 diagrammatically represented in Fig. 3 and also shown in Fig. 1, which spring tends to rotate the arm 52 in a clockwise direction, Fig. 3. The arm 53 in turn is provided with a spring 56 diagrammatically represented in Fig. 3, which tends to rotate the arm 53 in a counter-clockwise direction. This spring 56 is stronger than spring 55. Furthermore, the arm 53, Fig. 3, is provided with a tail piece 53' which is bent at right angles to the face of the arm and engages the cams 22 and 26 as shown in Fig. 4. Similarly, the arm 52 is provided with a tail piece 52' which is bent at right angles to the face of the arm and extends parallel to the axis of shaft 37. This tail piece is mounted in operative relation to the cams 32, 34, and 51.

When the current is turned on, the motor armature disk 2 rotates in the direction of the arrow, Figs. 1 and 2, which means, of course, that the gear 20 rotates in the opposite direction and therefore that the dial 25 rotates in the same direction with gear 20, that is, in a clockwise direction, as viewed in Fig. 8. The cams 22, 26, 32, 34 and 51, therefore, rotate in the direction indicated by the arrows as viewed in Fig. 10.

It will be understood that the maximum radii R^1 of cams 22, 26, 32 and 34 are all the same in length; that the radius R^2 of the cam 51 is shorter than the radii R^1 and is longer than the radius R^3 of cam 32, or than radius R^4 of cam 22, radius R^4 being longer than R^3. The two cams 22 and 26 are mounted side by side and the rim portion 56' of cam 26 forms

a continuation or extension of the rim portion 57 of the cam 22 with respect to the tail piece 53'. Similarly, the surface 59 of cam 34 forms a continuation or extension of the surface 60 of cam 32.

As indicated in Figs. 3 through 7, the arm 52 is provided on its end with a rod 62 of insulating material. Through the medium of this arm the contact springs 63, 64, and 65 are controlled. These contact springs are also shown in Fig. 11. The contact springs 63 and 64 respectively engage contacts 67 and 68, which latter are electrically connected together. The contact spring 65 similarly engages a contact 69. The contact springs 63, 64 and 65 are provided with suitable indentations 71, 72, and 73. The arm 62 oscillates beneath the springs 63, 64 and 65 and when the arm 62 finds a position in juxtaposition with either one of the said indentations the corresponding spring is allowed to fall into engagement with its corresponding contact, as indicated in Fig. 11, thereby permitting the circuit to be closed between this spring and its corresponding contact.

The arms 52 and 53 and the cams of Fig. 1 are so related that when the tail piece 53' is in engagement with the rim 57 of the cam 22, or with the rim 56' of the cam 26, the arm 53 is raised its maximum distance as shown in Figs. 5 and 6 and therefore the tail piece 61 is removed the maximum distance from arm 52, allowing the latter to make a complete forward stroke to the right. The first position of the stroke is shown in Fig. 4, the second in Fig. 5 and the final position is shown in Fig. 6. In these three positions the tail piece 52' of arm 52 engages respectively the following cam surfaces (Fig. 10): 60 (or 59 and 60), 82' and 83. This all takes place while the tail piece 53' of the arm 53 is riding on the surface 57 of cam 22 and before the element 53' clears the point 75 or the point 76 of cam 26, depending upon the adjustment of cam 26. As soon as the tail piece 53' clears the point 76 it falls on the surface 77 of cam 22, as indicated in Fig. 3, at which time the arm 53 carries the arm 52 back with it one step. Finally, when the tail piece 53 clears the point 78 it falls on the surface 79, at which time the arm 53 again advances the arm 52 to the position shown in Fig. 4. Arm 52, therefore, carries circuit controlling arm 62 back and forth, thereby controlling the signal circuits indicated in Fig. 11 in the proper sequence as indicated in Figs. 4, 5, 6 and 3. The signal indications corresponding to the positions of the arm 52 in Figs. 4, 5, 6 and 3 respectively are as follows: Fig. 4, green with contacts 64 and 68 closed; Fig. 5, amber with contacts 65 and 69 closed; Fig. 6, red with contacts 71 and 67 closed, and Fig. 3, amber with contacts 65 and 69 closed again.

Therefore, the drop from surface 77 of cam 22 to surface 79 thereof, Fig. 10, initiates the green signal, while the surface 60 of cam 32 determines the earliest time of cutoff of the green signal. On the other hand, cam 59 may be used to delay the time of this cutoff. The drop from points 80 or 81 of cams 32 or 34 on to cam surface 82' of cam 51 initiates the amber signal for the interval between the green and the red signals, and cam 51 may be used to regulate the length of this amber interval. The drop from point 82 of cam 51 on to surface 83 of cam 32 initiates the red signal while the drop from points 75 or 76 of cams 22 or 26 on to surface 77 cuts off the red and initiates the amber signal during the interval between the red and green signals and so on.

Referring to Fig. 11, the current for operating the motor and signals may be supplied over the line conductors 91, 92 the current reaching the motor by way of conductors 85 and 86. The current reaches the contacts 67, 68 and 69 by way of the conductors 87 and 88, returning to the other side of the line by way of the common return conductor 89.

Therefore by means of the motor, the cams, Fig. 10, are rotated and the contact springs 63, 64 and 65 are in turn operated in a given cycle of operation for correspondingly operating the signals R, A, G, Fig. 11. For example, the signals may be operated so as to appear on the main street in the following order R—A—G—A—R—A etc. or they may be operated in the following order R—A—G—R—A— etc. or in the following order R—G—A—R—G—A—R depending upon the adjustment of the cams 26, 34 and 51. It will be understood that if the cam 51 completely overlaps the cam 34 there will be no amber signal between the green and red, that is between G and R. On the other hand if the cam 26 completely overlaps the surface 77 on the cam 22 there will be no amber between the red and the green, that is between R and G. Therefore, by adjusting the cams 26 and 51, the length of the amber signals may be readily controlled.

It will be understood that as ordinarily installed at one intersection there are four groups of signals, one group facing one way on the main thoroughfare and another group facing in the opposite direction, each group corresponding to the group R, G, A, Fig. 11. A third group may be placed facing in one direction on a cross road and a fourth group facing in the opposite direction on the cross road, in which case there would be four red signals, R_1, R_2, R_3 and R_4, and four green signals G_1, G_2, G_3 and G_4, and four amber signals A_1, A_2, A_3 and A_4. Considering the R_1 and G_1 and R_3 and G_3 as being assigned to the main highway and R_2, R_4 and G_2, G_4 as being assigned to the cross road, the signals R_1, R_3, G_2 and G_4 would be put on one circuit, the signals G_1, G_3, R_2 and R_4, on another cir-

cuit, while the amber signals would all be put on a single circuit, or they may be divided into two circuits with the signals A_1 and A_3 on one circuit assigned to the main highway, and A_2 and A_4 on a different circuit assigned to the cross road. However, if the amber signals are to be built into two circuits, as indicated by the dotted lines, Fig. 11, two springs similar to spring 65 must be supplied. When all the amber signals are to be controlled over a single circuit only three springs are used, as indicated in Fig. 7, in which case the indentation 73 of spring 65 is broad enough to cover two positions of roller 62 for amber. When the amber signal circuits are split four springs are used and another spring is supplied next to 65, Fig. 7, the new spring and spring 75 each having an indentation broad enough to cover only one position of roller 62. The same cam arrangement is used in both cases.

It will be seen that with the arrangement of cams shown in Fig. 10 the controlling arm 52 assumes four different positions. However, it is possible to increase the number of positions that the arm assumes as for example by notching the cams 26 and 51 along their respective cam surfaces 56′ and 82′ in the same manner that the cam 22 is notched between the surfaces 57 and 77. In that case the arm 52 would have two additional intermediate positions, one between the amber and the red, that is between the cam surfaces 82′ and 83, and the other between the red and the amber, that is between surfaces 56′ and 77. Obviously with this arrangement it would be possible to have signals for the main highway as follows: R, RA, A, G, A, RA, R. In other words, the amber and the red would overlap in both instances, that is in passing from amber to red and in passing from red to amber. Similarly, it would be possible to notch the cam 34, thereby creating an additional step between the cam surfaces 59 and 82′, thus making it possible to overlap the green and the amber in passing from green to amber. By notching the surface 77 an additional step would be given to the cam so as to produce an overlap between the amber and the green in passing from amber to green. Obviously, the same variations may be produced with respect to the signals as viewed along the cross streets.

The device shown in Fig. 1 is provided with a flasher, which may be used when the other signals are thrown off. Inasmuch as the other signals are not on the same circuit with the flasher, the flasher will serve as a warning in case the other signals are thrown off or in case they go off accidentally. The flasher comprises the spring 49 and contact 50 connected in series with which is the flashing lamp 90 as indicated in Fig. 11. It will be seen that the spring 49 is under the control of the arm 48, which is operated to oscillate by means of the gear wheel 47 mounted on the shaft 37, as already explained.

In Fig. 11, X is a suitable switch for opening and closing the circuits to contacts 67, 68 and 69, and Y is a suitable switch controlling the flasher contact 50.

In connection with the construction, cams 22 and 32 may be considered as being main cams, and cams 26, 34 and 51 may be considered as auxiliary cams, cam 26 being adjustable relatively to cam 22, and cams 34 and 51 being adjustable relatively to cam 32.

It will be understood that while I have elected to illustrate and describe my invention in connection with the specific apparatus that I have illustrated, I do not wish to be so limited in as much as my invention contemplates variations and modifications within the scope of the claims contained herein.

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

1. In a circuit controller, in combination, a plurality of switches, an arm, cam means for operating said arm, and means whereby when the arm is operated said switches may be operated in turn, each independently of the other, said cam means comprising a pair of adjustable cam elements, a pair of adjusting elements one for and connected with each of said cam elements, said adjusting elements being located in front of a plane and said cam means being located behind said plane whereby said cams may be adjusted from a point in front said plane to vary the operation of said switches.

2. In a circuit controller, in combination, a plurality of switches, an arm, cam means for operating said arm, and means whereby when the arm is operated said switches may be operated in turn, each independently of the other, said cam means comprising a pair of adjustable cam elements, a pair of adjusting elements one for and connected with each of said cam elements, each of said cam adjustable elements being mounted on a different shaft together with its adjusting element, said shafts all having a common axis of rotation, said adjusting arms being all grouped together at one end of said axis whereby said cam elements may be adjusted from one point to vary the operation of said switches.

3. In a circuit controller, in combination, a plurality of switches, an arm, cam means for operating said arm, and means whereby when the arm is operated said switches may be operated in turn, each independently of the other, said cam means comprising a pair of adjustable cam elements, a pair of adjusting elements one for and connected with each of said cam elements, said adjusting elements being located in front of a plane and said cam means being located behind said plane whereby said cams may be adjusted from a point in front said plane to vary the operation of said switches, index means for each adjust-

ing arm for indicating the degree of adjustment, and means for latching said arms together whereby the said cam elements may be moved in unison after adjustment.

4. In a circuit controller, in combination, a driving element, a pair of main cams secured to said driving element, an auxiliary cam located in operative relation to one of said main cams, a second auxiliary cam located in operative relation to the other one of said main cams, a third auxiliary cam mounted in operative relation to the second auxiliary cam, the auxiliary cams being mounted to be adjusted independently, and index arms, one for each auxiliary cam, each arm being connected with its corresponding auxiliary cam, said arms being all located on one side of a plane and said cams being located on the other side thereof whereby any adjustment of said cams behind the plane may be performed from in front thereof.

5. In a circuit controller, in combination and having a common axis of rotation, a driving element, a shaft therefore, a pair of main cams secured to said driving element, an auxiliary cam located in operative relation to one of said main cams, a shaft for the auxiliary cam, a second auxiliary cam located in operative relation to the other one of said main cams, a shaft for the second auxiliary cam, a third auxiliary cam mounted in operative relation to the second auxiliary cam and a shaft for the third auxiliary cam, the shafts of the auxiliary cams being independently rotatable whereby the cams may be adjusted independently, and an index arm on the end of each shaft for indicating the adjustment of each auxiliary cam, said index arms being located on one side of a plane and the said cams being located on the rear thereof whereby said cams may be adjusted from a point in front of said plane.

6. In a circuit controller, in combination, an arm, a set of three switches, cam means for moving said arm into three different positions whereby the three switches may be operated one at a time each independently of the other, said cam means comprising three cam elements, each being adjustable independently of the other and with respect to said arm whereby the interval that the arm remains in each position may be varied, an index arm for each adjustable cam element, all of said elements of said controller being secured within a frame, said adjustable index arms being all located outside said frame whereby said cams may be adjusted from a point outside the frame.

7. In a circuit controller, in combination, a wall, a shaft which projects thorough said wall, a plurality of cams carried by said shaft at the rear of the wall, means for adjusting said cams relatively to each other, means for adjusting the effective lengths of said cams, and means located at the front of said wall for operating said adjusting means and fixing them in adjusted positions.

8. In a circuit controller, in combination, a wall, a shaft which projects thorough said wall, a plurality of main cams carried by said shaft at the rear of the wall, a plurality of auxiliary cams associated with the main cams for adjusting the effective lengths of the main cams, shafts for said auxiliary cams which extend forward to the front of said wall, and means on the auxiliary cam shafts in front of said wall for turning said shafts to adjust the auxiliary cams and fix them in adjusted positions.

9. In a circuit controller, in combination, a wall, a shaft which projects through said wall, a plurality of main cams carried by said shaft at the rear of the wall, a plurality of auxiliary cams associated with the main cams for adjusting the effective lengths of the main cams, concentric shafts for said auxiliary cams which terminate in front of said walls, a dial carried by the first named shaft in front of said wall, and adjusting arms carried by said concentric shafts and adapted to be fastened to said dial for locking the auxiliary cams in adjusted positions.

10. In a circuit controller, in combination, a driving element, a plurality of main cams secured to said driving element, auxiliary cams located in operative relation to the main cams, said auxiliary cams being mounted to be adjusted independently, and index arms, one for each auxiliary cam, each arm being connected with its corresponding auxiliary cam, said arms being all located on one side of a plane and said cams being located on the other side thereof, whereby any adjustment of said cams behind the plane may be performed from in front thereof.

In witness whereof, I have hereunto set my hand this 9th day of February, 1929.

CHESTER I. HALL.