Jan. 3, 1933. C. I. HALL 1,893,365

CIRCUIT CONTROLLER

Filed July 13, 1927 4 Sheets-Sheet 1

Fig. 1.

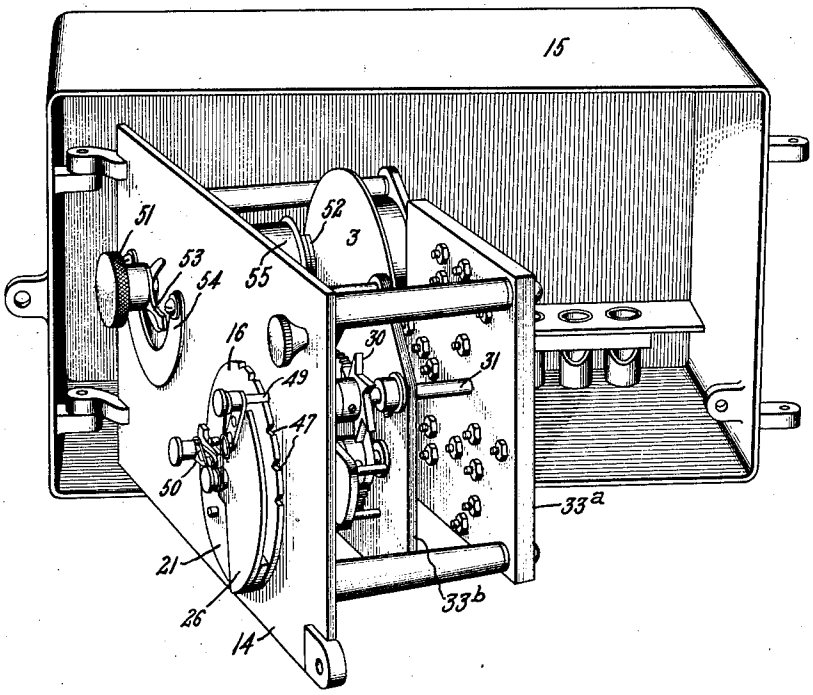
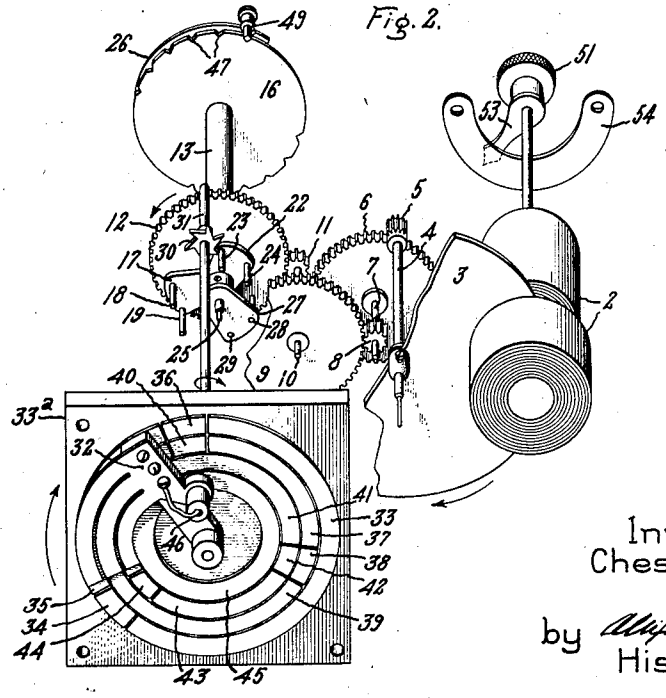


Fig. 2.



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CIRCUIT CONTROLLER

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Fig. 4.

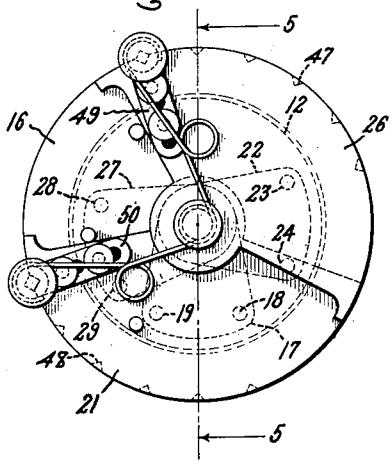


Fig. 5.

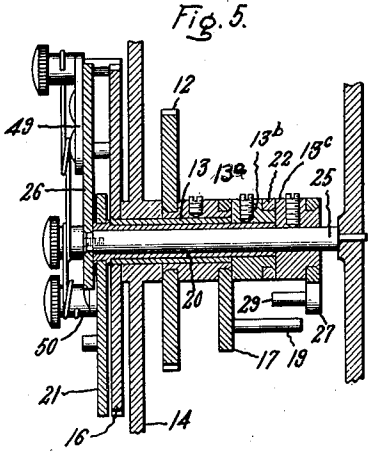
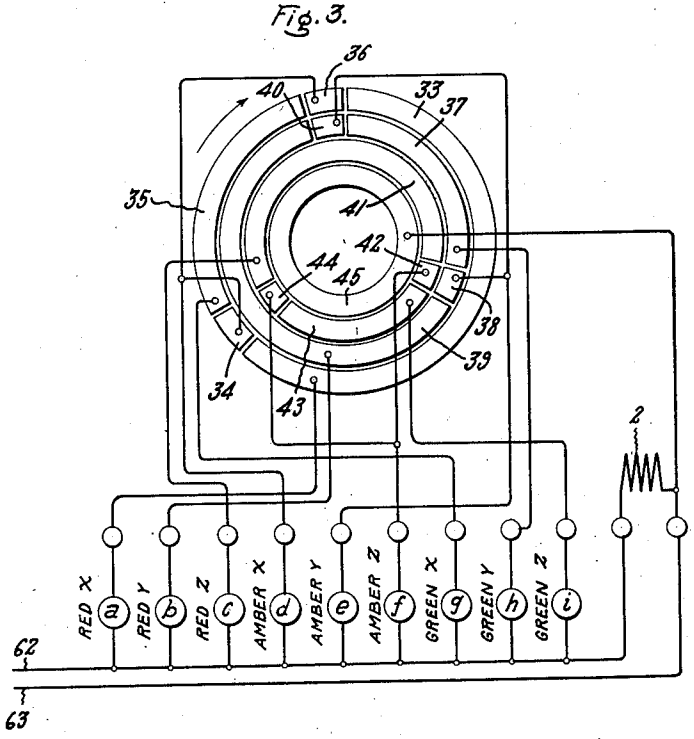


Fig. 3.



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CIRCUIT CONTROLLER

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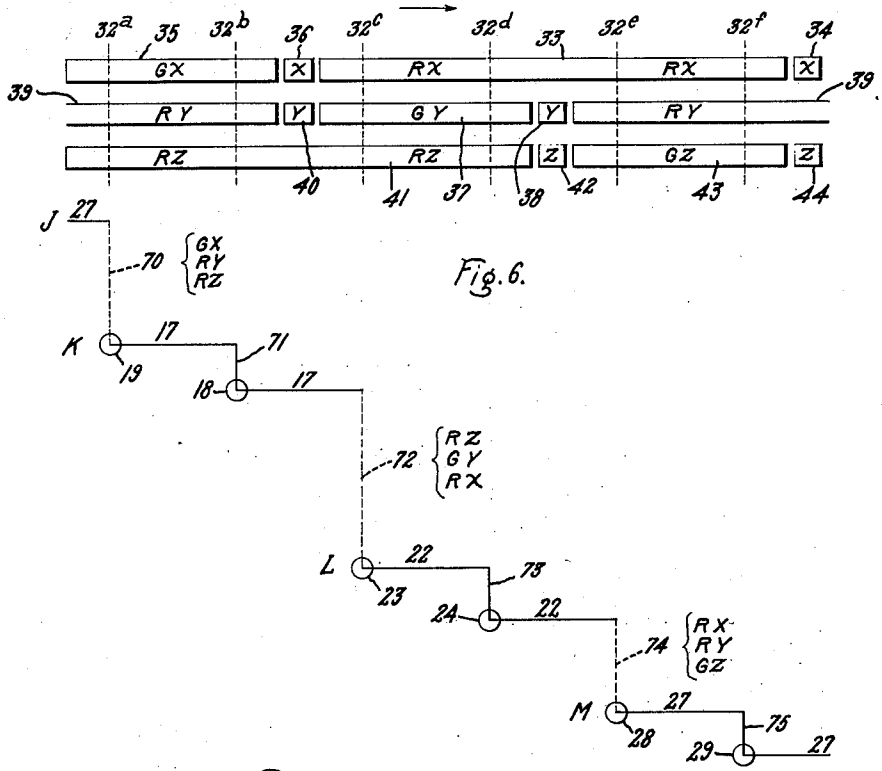


Fig. 6.

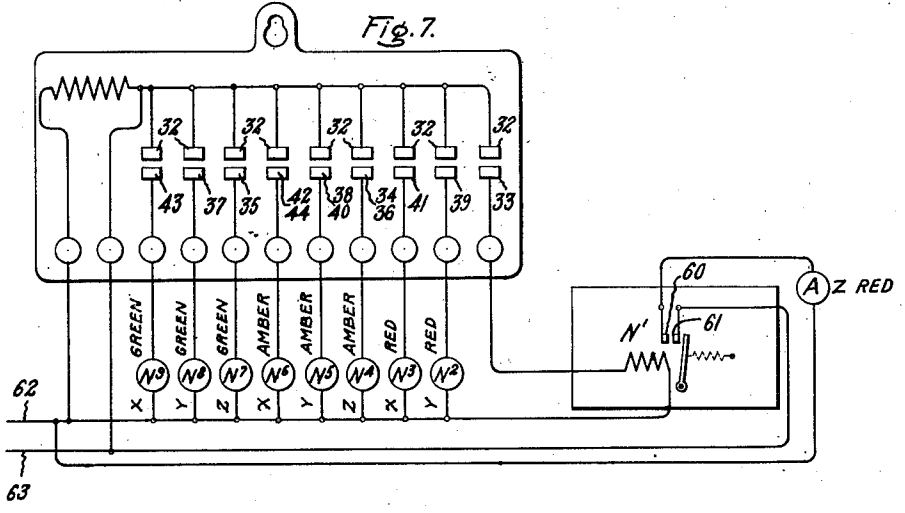


Fig. 7.

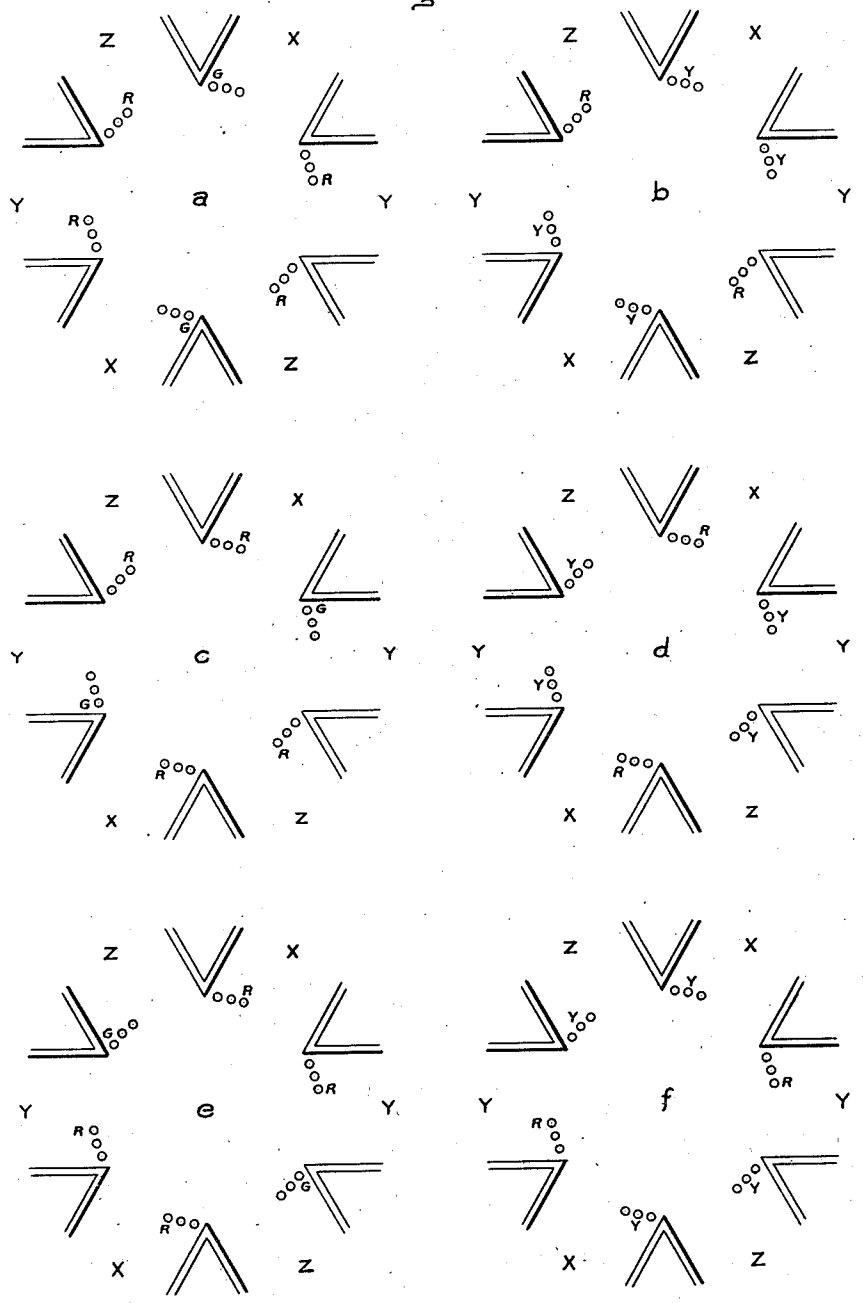
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CIRCUIT CONTROLLER

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Fig. 8.



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Patented Jan. 3, 1933 1,893,365

UNITED STATES PATENT OFFICE

CHESTER I. HALL, OF FORT WAYNE, INDIANA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

CIRCUIT CONTROLLER

Application filed July 13, 1927. Serial No. 205,512.

My invention relates to circuit controllers. More particularly it relates to circuit controllers of the type which are especially adapted for use in connection with traffic signals. In regulating traffic along a thoroughfare across which extend other avenues of traffic or cross roads, the time intervals during which the traffic is allowed to proceed along the main thoroughfare and along the cross-roads are not necessarily the same. In the case of a main and a cross-road, sometimes the ratio of the main-road traffic to the cross-road traffic is 1:1. The ratio 1:1 may, of course, be considered as 50:50 on the basis of 100. Sometimes the ratio of time during which the traffic in a main thoroughfare is allowed to go forward is 75 per cent of the total interval or cycle. This percentage, of course, may be varied.

Inasmuch as the volume of traffic in both the main thoroughfare and the cross-roads varies during the day, it is common practice to vary the ratio of a "go" interval in the main thoroughfare to the "go" interval in the crossroads. The signals for controlling the traffic may be light signals. For example, a red signal may be considered as a signal to stop, while green may be considered as a signal to go. Sometimes it is desirable to operate a third signal to indicate that a change from "go" to "stop" or from "stop" to "go" is about to be given. As a change-indicating signal, amber may be used.

In the case where three roads, X, Y, Z for example, cross at a given point, the time allotted to each street for traffic to proceed will be the same if the density of traffic is the same in all the streets, but if the traffic along the avenue X becomes twice as much as along the avenues Y or Z, then avenue X may be allotted twice as much time for traffic to proceed as either avenues Y or Z. On the other hand, the traffic may be such that the time allotted to each avenue will be different from that allotted to each other. The preferred arrangement is to have the "stop" signal red, and also that the "go" signal does not appear on any two streets at the same time, but only once along each street during each cycle of operation.

It is one of the objects of my invention to provide a traffic signal with signals for two or more roads that cross each other at a given point, and to provide a controlling device by means of which the cycle of operation is so apportioned that the signal for traffic to advance is followed by a signal indicating that a change is to take place followed by a stop signal which in turn is followed by another signal that traffic is to change, after which the cycle of operation is repeated.

It is an object of the invention to provide means for readily and conveniently changing the length of interval that the go and stop signals proceed along each one of the cross-roads and for changing the length of time of the complete cycle of operation.

Means for obtaining the foreging results are hereinafter more fully set forth and claimed, reference being had to the accompanying drawings which illustrate a form of the invention and in which Fig. 1 shows the controller mounted in a box, the door or cover of the box being shown removed from its hinges. The frame upon which the device is mounted as a unit is shown swung out of the box. In this figure several of the terminals of the circuits associated with the device are shown toward the rear of the box.

Fig. 2 is a diagrammatic perspective drawing intended to represent the relation of the various parts of the device to each other, among said parts being included the commutator and the brush which rotates over and in contact with said commutator. This figure shows a rear view of the commutator.

Fig. 3 shows in diagram and in rear view the commutator of Fig. 2. It also shows the circuit connections between the commutator and the light signals. In this figure the motor is also indicated.

Fig. 4 is a front view of the dials for varying the time interval of the signals during a single cycle.

Fig. 5 is a section of the same device taken along line 5—5, Fig. 4.

Fig. 6 is a schematic diagram showing the commutator segments in the order shown in Fig. 2 and diagrammatic circuit connections which will facilitate understanding the

method of operation of the elements under the control of the dials for varying the time intervals during which the brush remains in engagement with various segments of the commutator.

Fig. 7 shows a modified form of the device, Fig. 3, in diagram.

Fig. 8 is a diagrammatic layout of a given intersection of three crossroads showing the conditon of the signals at six successive periods indicated as A, B, C, D, E and F, respectively.

Referring more in detail to the drawings, it will be seen that I provide an electric motor, such as an electric induction disc motor, comprising field coils 2 and a rotatable disc 3. The disc is mounted on the shaft 4 which latter is provided with a pinion 5. This pinion is in engagement with a gear 6 which latter is mounted on a shaft 7 upon which shaft there is also mounted a pinion 8. The said pinion as shown is in engagement with a gear 9 which latter is mounted on a shaft 10 upon which shaft there is also mounted a pinion 11 in engagement with the gear wheel 12. The gear 12 is mounted on a hollow shaft 13 to which the gear is secured by set screw 13*a*, which shaft passes through the front plate 14 of the frame of the device, which frame is hinged within the case 15. On the outer end of the shaft 13, that is, in front of the plate 14, there is a dial 16 which is also secured to the hollow shaft 13 and rotates therewith. In other words, the dial 16 and the gear 12 are connected to turn together. On the opposite side of the gear 12, that is, on the side away from the dial 16, there is secured to the same shaft 13 an arm 17 provided with a pair of pins 18 and 19 located on the radial outer extremity of the arm. The arm 17 and the pins 18 and 19 are arranged to rotate with the shaft 13, the dial 16 and the gear 12, all about a common axis. Extending through the shaft 13 there is a second hollow shaft 20 to the outer end of which there is permanently secured a second dial 21. To the inner extremity of the shaft 20 there is permanently secured an arm 22, similar to the arm 17, and provided with a pair of pins, 23 and 24, near the outer radial extremity of the arm. With this arrangement whenever the dial 21 is rotated the arm 22 is rotated. Similarly by rotating the dial 16 the arm 17 is rotated.

Extending through the hollow shaft 20 there is a third shaft 25. The said shaft terminates at its outer end in the dial 26 which is just in front of the dial 21. Near the inner end of the shaft 25 there is provided an arm 27, near the outer radial extremity of which there are provided two pins 28 and 29. It will be seen that the pins 18 and 19 of the arm 17 and the pins 23 and 24 of the arm 22 extend parallel to the axis of rotation of the shaft 13 in an inward direction, that is, away from the dial 16. On the other hand, the pins 28 and 29 on the arm 27 extend in the reverse direction.

In proximity of the pins 18 and 19, 23 and 24, and 28 and 29 there is mounted a star wheel 30. The star wheel 30 is located on a shaft 31 to the inner end of which shaft there is secured a brush 32. The shaft 31 is provided with suitable bearings in both the front and back plates 14 and 33[a] of the frame of the device. It will also be seen that the rear end of the shaft 25 is also provided with a bearing in the rear plate 33[b] of the frame.

It will be seen therefore that as the arms 17, 22 and 27 rotate about their common axis they engage the star wheel 30 in sequence causing the intermittent rotation of the shaft 31 and consequently the intermittent advancement of the brush 32 over a commutator consisting of segments 33, 34, 35 and 36, forming one of three rings; also the segments 37, 38, 39 and 40 forming a second ring, and the segments 41, 42, 43 and 44 forming the third ring. Concentric with the segmental rings there is a fourth solid ring 45. It will be seen from the drawings that the brush 32 is constructed so as to slide over the segments of the first three rings and that a brush 46 is provided which slides over the solid ring 45, which brush is in electrical connection with the brush 32.

The object of providing the dials 16, 21 and 26 is as follows: The dial 16 is provided with a number of notches 47 on one side and a number of notches 48 on the opposite side. The dial 26 on the other hand is provided with a latch 49 which is adapted to slide radially so as to disengage the rim of the dial 16 in order that the dial 26 may be rotated with respect to the dial 16. When the proper relation between the two dials 16 and 26 is obtained the latch 49 is released and permitted to engage one of the notches 47 thereby maintaining a fixed relation between the dials 16 and 26. Under the circumstances the rotation of the shaft 13 necessitates the rotation of the dial 16 and when the latch 49 is in engagement with one of the notches 47, it also necessitates the rotation of the dial 26 in unison with the dial 16. The adjustment of the dial 26 effects an adjustment of the arm 27 and the pins 28 and 29 thereon with respect to the star wheel 30.

In a similar manner the dial 21 is provided with a latch 50 similar to the latch 49 which is arranged so as to operate in conjunction with the notches 48 to engage any one thereof, thereby making it possible to adjust the dial 21 with respect to the dial 16. The adjustment of the dial 21 results in an adjustment of the arm 22 together with its pins 23 and 24 with respect to the star wheel 30.

For the purpose of determining the degree of adjustment of the dials with respect to

each other, each of the notches 47 is marked with some kind of an index. For example the notches may be marked % to indicate percentages of the total time for a complete operating cycle or the time during which brush 32 makes one revolution. For example, the three dials may be adjusted with respect to each other so as to indicate an allotment to the brush 32 of 35 percent of the time to pass over the segments 37 and 38, 35 percent of the time over the segments 43 and 44, and 30 percent of the time over the segments 35 and 36. As will hereafter more fully appear this percentage of time represents the time that the green or "go" signal, together with the immediately following amber signal is displayed along a particular street.

The adjustment of the dials, as indicated, results in a corresponding adjustment of the arms 17, 22 and 27. With a device such as described the traffic officer can readily and in an instant change the ratio of the intervals of the display of green along two or more streets, the particular form of device shown being especially adapted for use at the intersection of three streets.

By means of the dials 16, 21 and 26 the ratio of the times that the green color is allotted to the various streets is regulated. In addition the total duration of the cycle may be varied by regulating the speed of the motor. This is done by means of the control knob 51. This knob is on the end of a shaft which extends through one of the coils 2 of the motor, which terminates in a shading coil 52, which shading coil, as is well known, affects the speed of the motor. Associated with the knob 51 there is a pointer 53 and a scale 54 which indicates in seconds the complete cycle of the operation of the brush 32 in travelling over the segments. The time of complete cycle may be varied, as for example between 50 seconds and 150 seconds.

It will be seen therefore that by operating the motor, the gear 12 is operated with the result that the shaft 13 together with all the dials 16, 21 and 26 are rotated simultaneously with the result that the arms 17, 22 and 27 are rotated about a common axis and brought into engagement consecutively with the star wheel 30.

With the means shown therefore, when one of the pins on the arm 17, the pin 19 for example, engages one of the teeth of the starwheel 30, assuming the brush 32 to be in the position shown in Fig. 2, the brush 32 advances until the pin 19 clears the tooth of the starwheel. The brush then pauses in a position still in engagement with the segment 35 just before reaching the segment 36. As the arm 17 advances the pin 18 next engages a tooth in the starwheel, carrying the brush across the segment 36 and into engagement with the segment 33 where the brush again pauses until the pin 23 on the next arm 22 engages the starwheel. The brush then advances once more pausing just before it reaches the segment 38 when the pin 23 clears the starwheel. As the arm 22 advances the pin 24 engages the starwheel causing the brush to again advance into engagement with the segment 38 and beyond into engagement with the segment 39 where it pauses once more until the pin 28 in the next arm 27 advances into engagement with the starwheel whereupon the brush advances once more, pausing just before it reaches the segment 34. As the arm 27 advances finally the pin 29 engages the starwheel advancing the brush across the segment 34 and allowing it to pause in the position shown in Fig. 2 after the pin 29 clears the starwheel. As the motor continues rotation the cycle of operation just described is repeated.

In Fig. 3 the connections between the various segments and the various members allotted to each one of the three intersecting streets X, Y, and Z are shown. It will be seen from this figure that the central ring 45 is connected with one side of the line that supplies the source of power whereas the other side of the line or source of power is connected in multiple to all of the members. Assuming that the segments of the outer ring are allotted to the street X and that the segments of the second outer ring are allotted to the street Y, and that the segments of the third ring are allotted to the street Z, the sequential operation of the members will be obvious from an inspection of Fig. 3 where the letters X, Y and Z represent the streets indicated.

In the foregoing I have described how the speed of the motor may be varied by rotating the element 52, Fig. 1. However, it is possible that the entire core of the coil 55 may be rotated by the knob 51 as a modified arrangement in which case the shading coil 52 would rotate with the core. By means of the shading coil 52, therefore, the speed of the motor may be regulated so that the cycle of operation may cover a certain interval of time, for example, 90 sec. or 150 sec. or an interval of time anywhere between such limits or between any other reasonable limits that may be deemed advisable.

In the particular form of construction shown in the drawings the commutator is flat. The inner ring 45 of the commutator is unbroken and as indicated is used to carry line current to the rotating brush which later makes contact with the three outer segment rings. The brush of course is not advanced continuously but in six successive steps for each revolution of the gear 12, the brush being advanced one step by each of the pins on the arms 17—22 and 27.

The pin and starwheel method of advance used in this construction makes it possible to vary the time the brush arms remain in the

different positions and therefore it makes it possible to vary the percentage of the time of each cycle of operation allotted to each of the three streets with respect to "go" signals or "stop" signals. This is done by changing the relative positions of the three arms 17, 22 and 27 as heretofore indicated by means of the adjusting knobs associated with the dials 16, 21 and 26. This is made possible, obviously, due to the fact that the arm 17 is fixed with reference to the gear 12 and also with reference to the dial 16, while the other two arms 22 and 27 are movable with respect to the dial 16, said arms being connected respectively to the adjustable sectors 21 and 26 of the dial through the medium respectively of collar 20 and shaft 25 within the collar 13, see Fig. 5.

Referring to Figs. 3 and 6, it will be seen that as the brush rotates the signal lamps would be operated as follows:

Period	Street X	Street Y	Street Z
1	Green	Red	Red
2	Amber	Amber	Red
3	Red	Green	Red
4	Red	Amber	Amber
5	Red	Red	Green
6	Amber	Red	Amber

The length of the amber time is not adjustable in the particular construction shown and is determined by the length of the time required for the brush to pass over the amber sectors of the commutator, to wit 36 and 40, 38 and 42, and 34 and 44. The amber time varies of course with the total time cycle.

The above operation may be better understood by reference to Fig. 6, which represents the commutator of Figs. 2 and 3 diagrammatically. The dotted line 32^a at the left of the figure crossing the segments 41, 39 and 35 is intended to represent the position of the brush 32 as shown in Fig. 2. The arrow at the top of the figure represents the direction of advance of the brush, that is from left to right in Fig. 6, and in a clockwise direction in Fig. 2. The dotted and solid lines to the right of the letters J—K—L—M are intended to indicate in a diagrammatic fashion the commutator regions in which the starwheel 30 and therefore brush 32 is engaged by the pins on arms 27, 17 and 22 and indicates also more in particular the points at which the various pins 19, 18, 23, 24, 28 and 29 enter into engagement with the starwheel.

For example, the line opposite the letter K indicates the region in which the pins 19 and 18 on the arm 17 engage the brush 32. At the point indicated by the circle 19, the pin 19 engages the starwheel and advances the brush to the position represented by the dotted line 32^b, in which position the brush pauses and the starwheel is engaged by the pin 18 and the brush is carried to the position represented by the line 32^c where it again pauses.

The line opposite the letter L represents the region in which the pins 23 and 24 on the arm 22 engage the brush 32. When the pin 23 engages the brush 32 it advances the latter to the position represented by the dotted line 32^d where it pauses and from which position the brush is advanced by the pin 24 to the position represented by the dotted line 32^e where it again pauses.

The line opposite the letter M represents the region in which the pins 28 and 29 engage the brush which pauses after each advance. This region also corresponds with the region represented by the letter J. The pin 28 operates to advance the brush from the position represented by the dotted line 32^e to that represented by the dotted line 32^f. From this last position the pin 29 advances the brush to the position 32^a as previously explained. It will be seen that the length of the pause in the position 32^a is represented by the dotted line 70, while the line 71 represents the length of the pause in the position 32^b. Similarly, the dotted line 72 represents the length of the pause in the position 32^c, the line 73 represents the pause in position 32^d, the dotted line 74 represents the pause in position 32^e, and the line 75 represents the pause in position 32^f.

Inasmuch as the pins 19 and 18 are on the same arm, the line 71 represents a time interval that is not adjustable. For a similar reason the line 73 represents an interval that is not adjustable; that is for the reason that the pins 23 and 24 are on the same arm. For a similar reason the interval represented by the line 75 is not adjustable; that is because the pins 28 and 29 are on the same arm. However, the intervals represented by the line 70, by the line 72, and by the line 74 are adjustable inasmuch as the arms 27 and 22 are adjustable with respect to the arm 17. Obviously adjusting the arm 27 varies the length of the lines 74 and 70. Where it lengthens one it shortens the other, but it does not affect the interval represented by the line 72. Similarly, by adjusting the arm 22 with respect to the arm 17, the intervals represented by the lines 72 and 74 are varied, that is, may be increased or decreased. Increasing the intervals represented by line 74 may have the effect of either decreasing the interval represented by either line 70 or line 72 depending upon whether the arm 17 is moved together with the arm 22 or not. Therefore, the line 74 represents the interval of time during which red is displayed along the roads Y and X and during which green is displayed along the road Z. The interval represented by the line 72 indicates the length of time that green is displayed on the street Y and red displayed on the streets Z and X. The line 70 repre-

sents the interval of time that green is maintained on the street X and red on the streets Y and Z. Therefore by moving the arm 17 alone 70 is shortened and 72 is lengthened or vice versa. By moving the arm 22 alone 72 is shortened and 74 is lengthened, or vice versa, and by moving 17 and 22 simultaneously 70 is shortened and 74 is lengthened, and vice versa. It will be seen that the brush 32 in passing from position 32^b to 32^c maintains the red signal on the street X and that in passing from 32^d to 32^e the red is maintained along the street Z, while in passing from 32^f to 32^a the red is maintained on the street Y. For this reason the percentages indicated on the dial elements are in terms of green, since green changes each time that the brush passes over any one of the amber segments. In Fig. 6, X, Y and Z in connection with the segments represent the streets X, Y and Z, while R and G represent red and green respectively. Each of the squares 36—40, 38—42, 34 and 44 represent amber, therefore, the squares A represent amber on street X and the squares Y represent amber on the street Y, and the squares Z represent amber on the street Z.

The modified form of the device shown in Fig. 7 is along the same line as the device shown in Fig. 3 except that relays N^1, N^2, N^3, N^4, N^5, N^6, N^7, N^8 and N^9 are substituted one for each of the lamps *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h* and *i*, Fig. 3. With this arrangement when the brush 32 of the commutator closes a circuit through the contact 33 for example, the relay N^1 becomes energized instead of the lamp *a*. The result is that the relay N^1 becomes energized and closes the circuit between the contacts 60 and 61 with the result that the lamp A corresponding to the "Z" red lamp of Fig. 3 becomes lighted. In other words, the modified form of the device shown in Fig. 7 consists in interposing relays between the commutator contacts and the lamps. The advantages of this arrangement is that the volume of current that flows through the brush 32 may be very materially reduced, thus reducing the wear of the brush and contacts of the commutator due to the current flow through the device. It will be understood that in Figs. 3 and 7 the conductors 62 and 63 are connected with a suitable source of current supply.

It will be understood that while I have shown and described my invention in connection with devices of specific construction in order to comply with the law, applicant does not wish to be limited to the particular form and construction of the invention shown inasmuch as in view of the disclosure variations may be readily carried out without departing from the spirit of the invention or 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, a contact structure comprising a plurality of rings of segmental contacts, a brush structure having fingers which engage said contacts, a shaft on which one of said structures is mounted, a star wheel fixed on said shaft, a second shaft, a plurality of pins carried by said second shaft to turn therewith, said pins being adapted to engage the star wheel to impart step by step turning movement thereto, a motor for driving the second shaft, and means for adjusting said pins relatively to each other around said second shaft.

2. In a circuit controller, a contact structure comprising a plurality of rings of segmental contacts, a brush structure having fingers which engage said contacts, a shaft on which one of said structures is mounted, a star wheel fixed on said shaft, a plurality of concentric shafts, pins carried by said concentric shafts for engaging the star wheel to impart turning movement to said first named shaft, means for adjusting said concentric shafts relatively to each other and for locking them in adjusted positions, and means for turning said concentric shafts as a unit.

3. In a circuit controller, a frame comprising a front plate, a contact structure comprising a plurality of rings of contacts, a brush structure which engages said contact structure, a shaft supported in the frame on which one of said structures is mounted, said structures being at the rear of said front plate, projecting members on said shaft, a plurality of shafts adjacent said first named shaft, each provided with means adapted to engage said projecting members to turn the first named shaft, ends of said plurality of shafts extending to the front of said front plate, means on such ends for adjusting the shafts circumferentially relatively to each other and for locking them in adjusted positions, and means for turning said plurality of shafts as a unit.

4. In a circuit controller, cooperating circuit controlling members, one of which is movable relatively to the other, a shaft on which the movable member is mounted, a plurality of projections on said shaft, a second shaft adjacent to the first named shaft, a plurality of projections on the second shaft adapted to engage those on the first named shaft for imparting intermittent turning movement to the first named shaft, means for adjusting one set of projections relatively to each other about the shaft on which they are mounted, and means for driving the second named shaft.

In witness whereof, I have hereunto set my hand this eleventh day of July, 1927.

CHESTER I. HALL.