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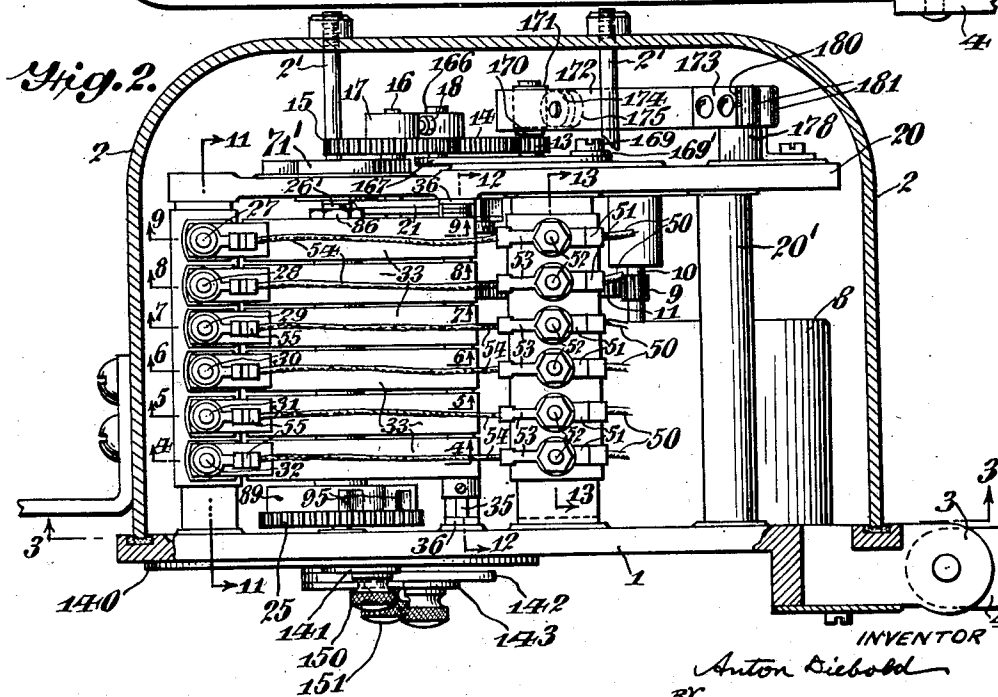
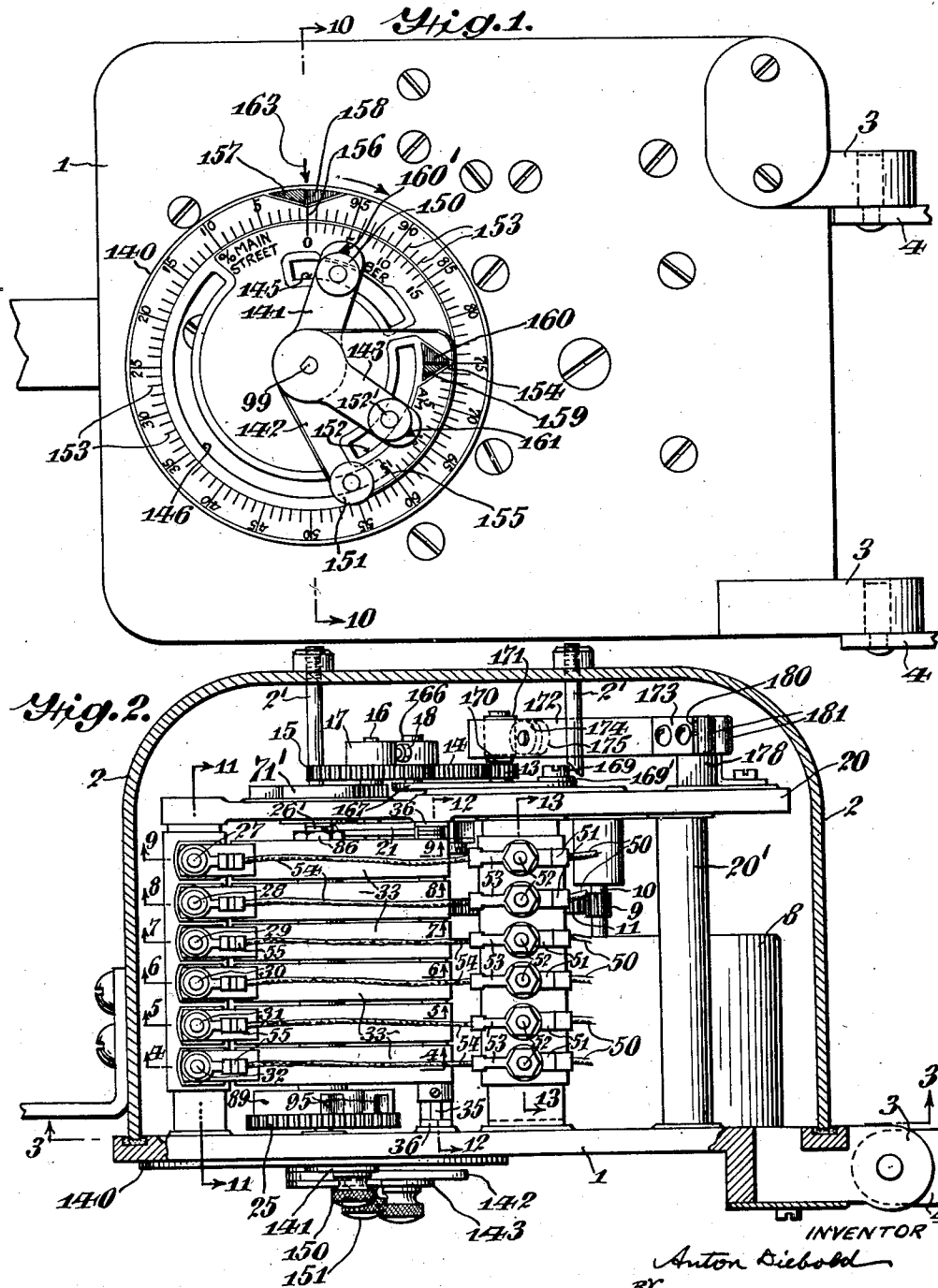
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2,045,127

ELECTRIC SWITCH CONTROL MEANS

Filed April 11, 1931

5 Sheets-Sheet 1



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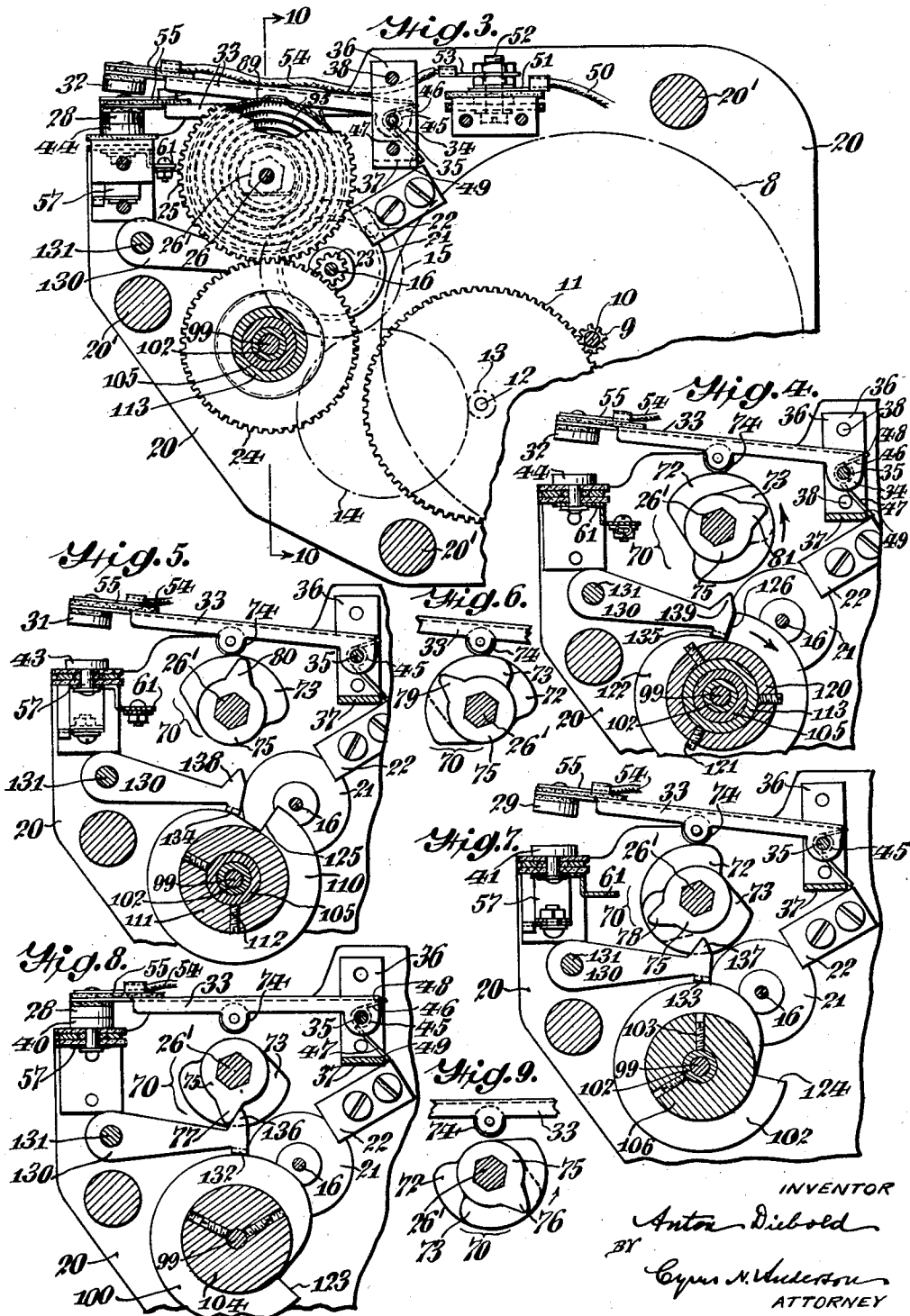
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5 Sheets-Sheet 2



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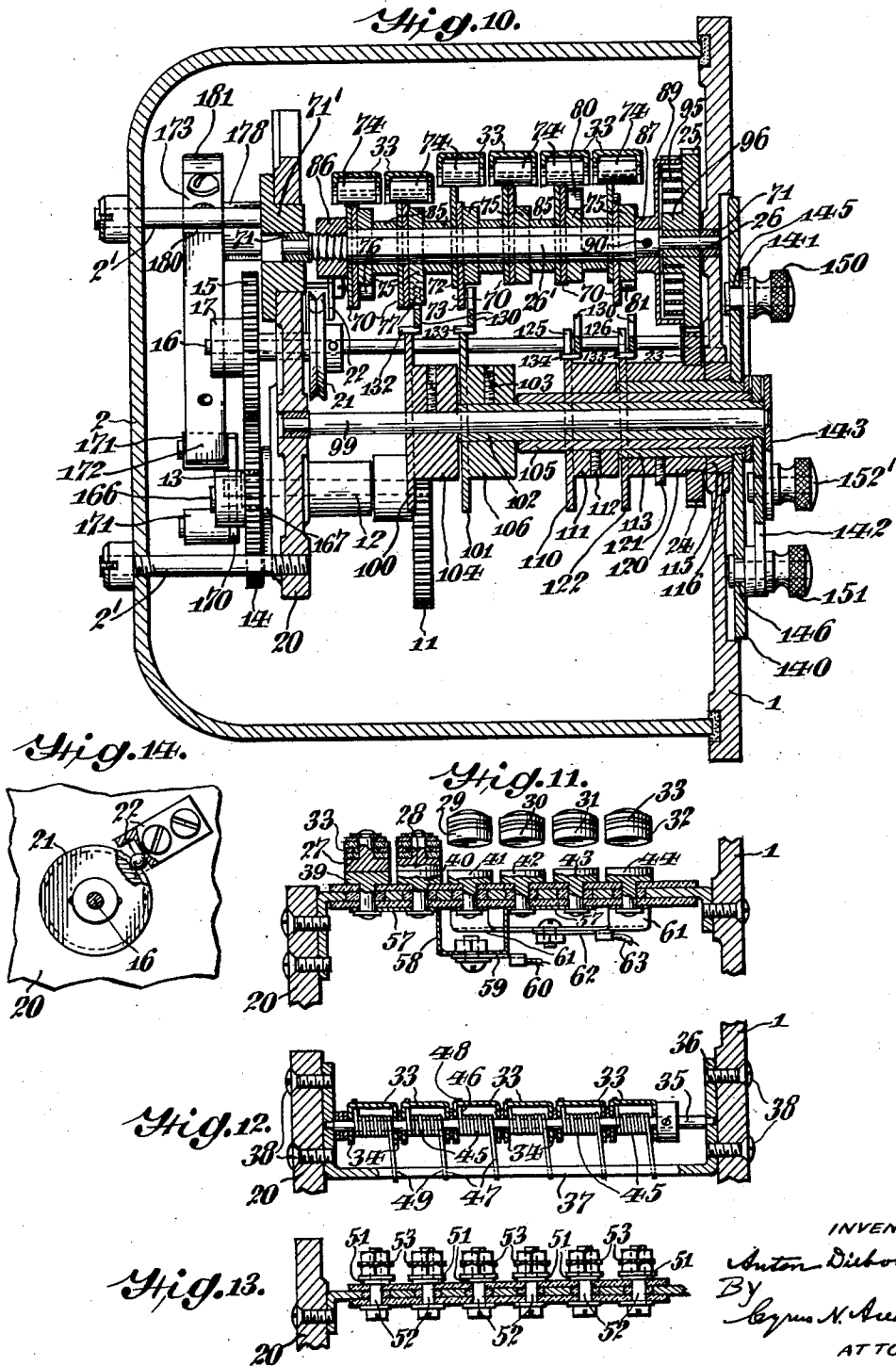
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ELECTRIC SWITCH CONTROL MEANS

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June 23, 1936.

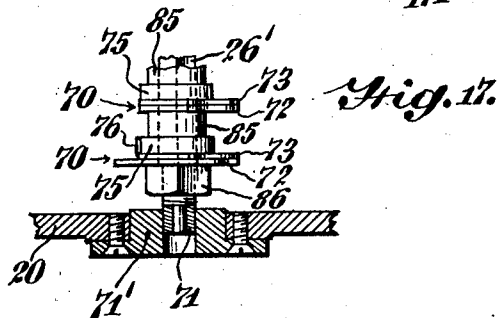
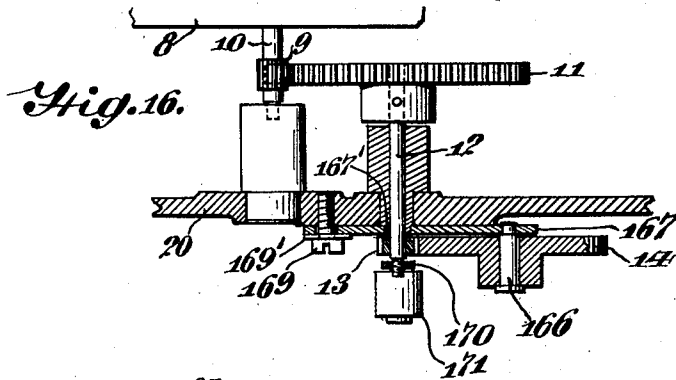
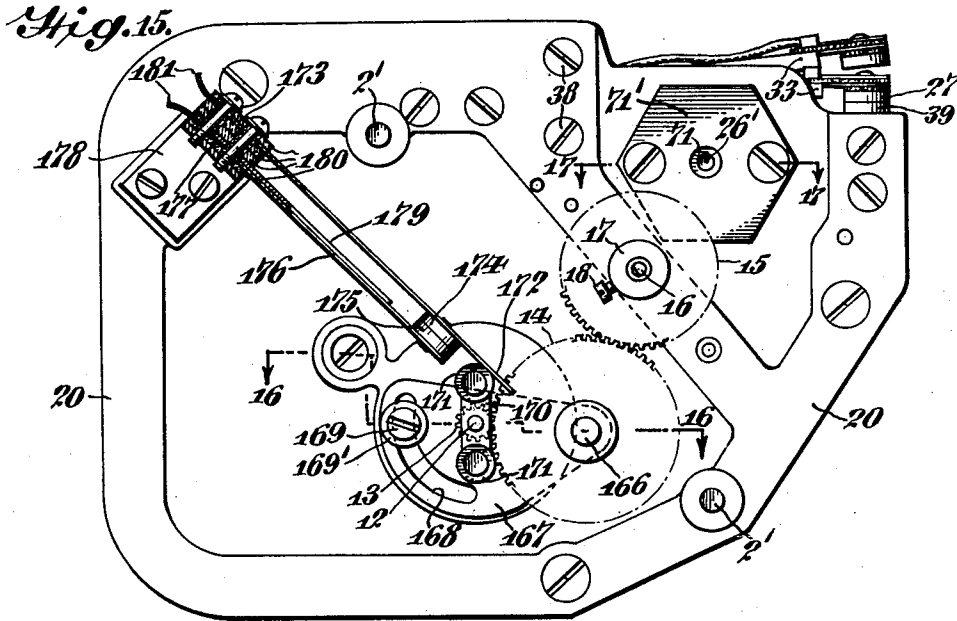
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5 Sheets-Sheet 4



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ELECTRIC SWITCH CONTROL MEANS

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Application April 11, 1931, Serial No. 529,427

29 Claims. (Cl. 200—27)

My invention relates to electric switch control means which is adapted for use for various purposes but it has been designed by me primarily for use in the manipulation and controlling of electric switches the opening and closing of which controls the electric signal lights employed at crossings of highways, streets and the like to aid in the direction and control of traffic.

The general object of the invention is to provide means of novel construction embodying mechanism for automatically opening and closing successively the switches of a group or plurality of switches and maintaining the same in opened or closed position during such periods of time as may be desired and predetermined.

It also is an object of the invention to provide mechanism of the character indicated which is flexible in character and which has parts which may be so adjusted and set as to control a plurality of switches in a manner to maintain electric light signals in such order and in such relation to each other as may be desired and predetermined.

A further object of the invention is to provide a mechanism for the purpose suggested having means of novel construction for effecting the adjustment of certain parts of the structure at will to vary the setting or positioning thereof with relation to other parts to thereby vary the timing of the opening and closing of certain switches and to vary the time periods during which the said switches may be held in opened or in closed positions.

A still further object of the invention is to provide mechanism of the character indicated having means of novel construction for controlling the movements of the cam means or unit for actuating the switches to open and to permit closing thereof.

Another object of the invention is to provide means associated with the switch mechanism and actuated by a moving part of the machine to cause the continuous operation of said switch mechanism to successively open and close a plurality of switches for controlling a plurality of electric circuits to effect the lighting and extinguishing in proper sequence of a plurality of lights.

Without setting forth in greater detail at this point the more general and specific objects of the invention I shall proceed to a detailed description thereof wherein additional objects and advantages will be either referred to specifically or else will be apparent therefrom.

In order that the invention may be readily un-

derstood and its practical advantages fully appreciated reference should be had to the accompanying drawings in which I have illustrated a preferred form of the invention. However, it will be understood that the invention may be embodied in other forms of construction than that shown and that changes in many of the details of construction may be made within the scope of the claims without departing from the said invention or the principle thereof.

In the drawings:

Fig. 1 is a view in front elevation of electric switch control means embodying the invention;

Fig. 2 is a view in horizontal sectional plan thereof;

Fig. 3 is a view in vertical sectional elevation taken on the line 3—3 of Fig. 2;

Figs. 4, 5, 6, 7, 8, and 9, respectively, are views in vertical elevation taken on the lines 4—4, 5—5, 6—6, 7—7, 8—8, and 9—9 of Fig. 2, showing fragmentary portions of the structure;

Fig. 10 is a vertical trasverse sectional view taken on the line 10—10 of Figs. 1 and 3;

Fig. 11 is a vertical transverse sectional view taken on the line 11—11 of Fig. 2 showing a fragmentary portion of the structure;

Fig. 12 is a similar view taken on the line 12—12 of Fig. 2;

Fig. 13 is a similar view taken on the line 13—13 of Fig. 2;

Fig. 14 is a view partly in section and partly in elevation taken from the inside of the frame of the machine and showing a clutch device;

Fig. 15 is a view partly in rear elevation and partly in section of the device, with the cover removed;

Fig. 16 is a view in section taken on the line 16—16 of Fig. 15;

Fig. 17 is a horizontal sectional view taken on the line 17—17 of Fig. 15;

Fig. 18 is a view, diagrammatic in form, with the parts enlarged which are shown therein and spread apart so as to indicate more clearly their cooperative relation to each other;

Fig. 19 is a view showing a detail of the construction of one of the cams and a stop device associated therewith with the means for supporting the same; and

Fig. 20 is a sectional view of a fragmentary portion of the structure showing a double acting cam for actuating one of the movable switch contacts.

In the drawings I have shown at 1 a plate upon which the means embodying my invention is mounted. It is adapted to receive and to have

secured thereto a cover 2, the said cover and the plate 1 constituting a casing within which the mechanism of the device is concealed and protected. The cover is held in place by bolts 2' secured at their inner ends to an adjoining side of the frame of the device. The only portion of the structure which is exposed is certain adjusting means which hereinafter will be referred to and more fully described. The plate 1 may and usually does, when the device is in use, occupy a vertical plane. In order to pivotally support the device upon any suitable support I have provided what may be regarded as the inner edge of the plate with spaced lugs or ears 3 having openings therein which register with each other for the reception of pivot pins by which the said ears are pivotally connected with spaced supports 4.

For the purpose of operating the switch actuating and controlling means, including cams and stop devices, I may employ any suitable power means. Preferably I employ an electric motor, indicated in general outline at 8, which may be a synchronous motor or an induction motor. If the former is used mechanical means may be employed to effect or bring about a speeding up or a slowing down of the operation of the contact actuating means. If, on the other hand, an induction motor is employed, the speeding up or slowing down of the operation of the contact actuating means may be effected by adjusting shading coils which will be associated with such motor, all in known manner. In the construction as illustrated I have employed a synchronous motor and accordingly shall later on herein refer to and describe the means by which a speeding up or slowing down of the operation of the contact actuating means may be effected.

For the purpose of transmitting power from the motor to actuate the parts of the mechanism of the device I provide a small gear or pinion 9 mounted on the rotor shaft 10 of the motor, which pinion is in mesh with a relatively large spur gear 11 on the shaft 12 on which a small gear or pinion 13 is mounted which meshes with and drives a gear 14 which in turn meshes with and drives a gear 15 which is retained in place upon one end of the shaft 16 by means of a sleeve 17 removably held in place by means of a binding screw 18. The end portion of the shaft 16 in adjoining relation to the gear 15 is journaled in an opening formed in the side 20 of the frame of the device, the said side being connected with the side 1 by means of connecting bars or rods 20'. A grooved disc 21 is secured to the shaft 16 in adjoining relation to the inner surface of the side 20 with which is in engagement a ball clutch device indicated as a whole at 22. The said clutch device acting upon the disc 21 in known manner and as indicated in Fig. 14 prevents rotation in reverse direction of the said disc and of the shaft 16 to which it is secured. The opposite end of the shaft 16 is journaled in the opposite front side 1 of the casing. A small spur gear or pinion 23 is mounted upon the shaft 16 in adjoining relation to the inner side of the plate 1. It is in engagement with and drives the spur gear 24 which in turn is in engagement with and drives the spur gear 25 which is mounted upon the reduced end portion 26 of a polygonal shaft 26', the said gear 25 being rotatable independently of the said shaft. (See Fig. 10.) Whether the motor employed as the energy producing means for actuating and driving the gears previously re-

ferred to is of the synchronous or induction type the rotor shaft thereof is driven at a substantially constant speed which is continued so long as current is supplied thereto. Usually a sixty-cycle current will be employed to energize the motor but currents of other cycles may be employed.

If the pinion 9 is driven continuously it will be apparent that the train of gears connected with and operated thereby also will be driven continuously and at constant speed.

For the purpose of opening and closing a plurality of circuits I have provided movable contacts 27, 28, 29, 30, 31, and 32 upon and insulated from the outer swinging ends of pivoted contact carrying members 33. Each of the said contact carrying members is provided with spaced downwardly extending ears or projections 34 which have openings therethrough through which extends a pivot rod or shaft 35 upon which the said contact carrying members are pivoted. The opposite ends of the shaft are supported in projecting portions 36 which are provided at the opposite ends of the crosswise extending bar 37. The portions 36 are secured by means of fastening screws 38 to the front and rear sides 1 and 25 of the frame. For the purpose of holding or tending to hold the contact carrying members 33 downwardly or in their lowermost positions with the contacts 27 to 32, inclusive, in contact with the stationary contacts 39, 40, 41, 42, 43, and 44 I have provided springs 45 which are coiled about the pivot rod 35 between the ears 34 and which have projecting ends 46 and 47, each of the former being in contact with the inner end of a movable contact carrying member 35 in adjoining relation to the pivot rod 35 as indicated at 48. The other projecting end 47 of each of the springs contacts with the stationary cross bar or plate 37 as indicated at 49. These springs are under continuous tension and tend to cause downward pivotal movement of the movable contact carriers 33.

The system of circuits within which the lights to be controlled are located is not shown but I have shown portions of the said circuits as indicated at 50. There are a plurality of conductors the end portions of which are shown at 50 which end in metal terminals 51 which are connected to and insulated from binding posts 52. Metal terminals 53 also are connected to the said binding posts. The ends which project away from said posts are connected with relatively short conductors 54 the opposite ends of which are connected to metal terminals 55 which in turn are connected with the movable contacts mounted on the outer swinging ends of the contact carrying members 33.

In order to connect the contacts 39, 40, 42, and 43 in certain of the circuits I have provided a metal bridging or connecting member 57 the opposite end portions of which are connected to the said contacts. The downwardly projecting portion 58 of the connection 57 bridges a contact 41. To the said downwardly projecting portion 58 a terminal 59 is connected the outer end of which is connected to a conductor an end portion of which is shown at 60. For the purpose of connecting the contacts 41 and 44 in certain of the circuits I have provided the bridging connection 61 the opposite ends of which are connected to the said contacts. To the intermediate bridging portion of the connection 61 a terminal 62 is connected to which is connected a conductor an end portion of which is indicated at 63.

For the purpose of successively actuating the

movable switch contacts 27 to 32, inclusive, I have provided a cam unit associated with means for controlling the movements thereof. The cam unit comprises a plurality of cams 70 mounted in spaced relation to each other upon the polygonal shaft 26' which shaft in the construction shown is of hexagonal shape in cross section in order that the said cams may be adjusted readily about the said shaft through angles of sixty degrees.

The opposite end portions of the shaft 26' are reduced and are journaled in bearing bushings 71 one of which is fixed in an opening in the plate 1 while the other is fixed in an opening provided in a bearing block 71' removably mounted in an opening in the said plate 20. The removal of the bearing block 71' facilitates the removal of the shaft 26' supporting the cams for actuating the switches. Each of the cams 70 preferably is made up of two disc-like parts or plates 72 and 73 mounted in adjoining relation to each other. Each of the parts 72 and 73 is or may be of different shape so that by adjusting the said parts relatively to each other the shape of the cam embodying the said two parts may be changed. It will be noted that rollers 74 provided upon the under sides of the contact carrying members 33 are adapted to ride upon the edges of the cams 70. The relation of the rollers 74 to the edges of the cam discs is quite clearly shown in Fig. 18 of the drawings. By adjusting the parts 72 and 73 of the cams 70 with relation to each other the periods during which the movable switch contacts may be held out of contact with the stationary contacts and the periods during which the said movable contacts may be permitted to contact with the said stationary contacts may be varied. By such variation a change in the periods of light and darkness of the controlled lights may be effected.

In the construction as illustrated I have shown discs 75 supported upon the shaft 26' in adjoining relation with the cams 70. Said discs are provided with hexagonal openings so that when they are placed upon the hexagonal shaft 26' they cannot turn with respect to the latter. The said discs are provided with stop projections 76, 77, 78, 79, 80 and 81 which projections extend radially of the axis of the shaft 26'. Adjoining projections extend in directions at an angle of sixty degrees with respect to each other. Assuming for example that the projection 81 extends in a certain direction, the projection 80 will extend in a direction differing from the direction of the former by an angle of sixty degrees, and so on throughout the remainder of the projections 79, 78, 77, and 76. In the construction as illustrated, which is arranged to operate the switches to produce what I regard as a four period timing operation of the cams, two of the projections, 76 and 79, are without utility and might be omitted, but as the said stops are adapted to function and do have utility in case of a construction in which a five or a six period timing operation of the cams is employed it is preferred to leave the said projections 76 and 79 in place as shown. The several groups of cam discs and discs 75 are retained in spaced relation to each other on the shaft 26' by means of spacing sleeves 85.

The cam 70 at one end of the shaft 26' is retained in place upon the hexagonal end portion thereof by means of a retaining nut 86 while the cam and associated stop at the opposite end of the said shaft are retained in place thereon by means of the hub 87 of a drum or housing 89. The said drum or housing and its hub are secured

in place upon the shaft by means of a fastening pin 90 which extends through the hub and the shaft. It may be noted that the outer end of the hub is flush with the inner end of the reduced portion 26 of the said shaft 26'.

For causing rotation of the shaft 26' with the cams and the stop projections thereon I have provided a coiled spring 95 which is located within the housing 89 and is coiled about the inwardly extending or projecting portion of the hub 96 of the gear 25 previously referred to. One end of the said spring is connected to the said hub while the opposite end thereof is connected to the outer or perimetrical portion of the drum 89. The cam unit, including the cams 70, is releasably held against rotation by means which hereinafter will be described in detail. One end of the spring 95 being connected to the hub 96 of the gear 25 with the opposite end thereof connected to the housing 89 and the latter being held against rotation, it follows that the rotation of the gear 25 will wind up and place the spring 95 under tension so that when the cam unit is released the said spring unwinds or partially unwinds and causes quick and rapid rotative movement of the cam unit in counter-clockwise direction in order to adjust the same into a different position. In moving to such latter position different groups of the movable switch contacts will be actuated so as to change their positions from those which they have occupied previously. This operation is successively continuous so that there is a continuous and successive changing of the positions of the movable switch contacts.

For the purpose of controlling the movements of the cam unit for actuating the movable switch contacts I have provided a timing cam unit between which and the stop projections mounted upon the shaft 26' are located a plurality of stops which are adapted to engage the said projections and adapted to be controlled by the respective cams of the said timing cam unit. As already indicated I have shown my invention as embodied in a construction adapted to provide in each cycle of operation four timing period operations of the cams on the shaft 26' but as previously indicated the construction may be adapted to provide five or six timing periods of the cams for actuating the contacts by the inclusion of additional cams in the timing cam unit.

The timing cam unit comprises a shaft 99 journaled at one end in a bearing provided in the side 20 and supported at its opposite end in the manner as hereinafter will be described. A plurality of cam discs are supported upon the shaft 99 in spaced relation to each other and in cooperative relation to certain of the cams 70 and the stops associated therewith. The cam disc 100 is mounted directly upon the shaft 99 and fastened thereto so that it will rotate therewith. The said cam 100 is located beneath the cam 70 with which is associated the stop projection 77. A cam 101, which is that next adjoining the cam 100, is mounted upon a tubular shaft or sleeve 102 which is mounted upon and is concentric with the shaft 99 and is rotatable relatively to the latter. The cam 101 is secured to the inner end portion of the tubular shaft 102 by means of a binding screw 103 as shown in Fig. 10. The cam 100 is integral with a hub portion 104 which serves as a spacing means between it and the inner end of the tubular shaft 102. A tubular shaft 105 is mounted upon the tubular shaft 102 with its inner end terminating outwardly of the inner end of

the said shaft 102. A thickened hub-like portion 106 integral with the cam disc 101 serves as a spacing means to position the said cam 101 with respect to the inner end of the tubular shaft or sleeve 105. The said cam 101 is located underneath that one of the cams 70 with which is associated the stop projection 78, the said projection being shown in Figs. 7 and 18. A cam disc 110 is mounted upon the tubular shaft 105 which disc is provided with an enlarged hub-like portion 111 which is secured to the said tubular shaft 105 by a binding screw 112. The cam disc 110 is located underneath and very nearly in the same plane as that of the cam 70 with which is associated the cam projection 80. A third tubular shaft or sleeve 113 is mounted upon the tubular shaft 105 with its inner end located in adjoining relation to the outer side of the hub 111. The outer end of the tubular shaft or sleeve 113 is mounted within a bushing 115 supported in an opening 116 provided in the plate 1 and projects a short distance beyond the said bushing and side. The outer end of the next inner tubular shaft or sleeve 105 projects beyond the outer end of the shaft or sleeve 113. The outer end of the innermost shaft or sleeve 102 projects beyond the outer end of the intermediate tubular shaft or sleeve 105. The purpose of these projecting end portions will be adverted to and explained later on herein. An outer sleeve 120 is mounted upon the portion of the shaft or sleeve 113 inside of the plate 1 and is secured to the said sleeve by means of a binding screw 121. The inner end of the said sleeve 120 is provided with a timing cam 122. The gear 24 is mounted at the outer end of the said sleeve 120 in adjoining relation to the inner side of the plate 1.

It may be noted that the several discs 100, 101, 110, and 122 may be adjusted rotatably as well as lengthwise of the several shafts by which they are supported merely by loosening the binding screws by which they are secured to the said shafts.

The shapes of the timing cam discs are best shown in Figs. 4, 5, 7, 8, and 18. It will be observed that each of the discs is provided with a shoulder, the shoulder of the disc 100 being shown at 123, that of the disc 101 being shown at 124, that of the disc 110 being shown at 125, and that of the disc 122 being shown at 126. The timing cam unit, in the operation of the machine, rotates in a clockwise direction, opposite that of the rotation of the cam unit for operating the movable switch members. The cams of the timing cam unit may be varied in shape to meet the desires of the designing engineer. The same may be said of the cams which are mounted upon the shaft 26'. It may be remarked also with respect to the last named cams that instead of constructing each of them of two members as above described they each may be constructed of a single member. It is preferred, however, to employ two members because then by adjusting such members relatively to each other the shapes of the respective cams may be varied readily and economically. If each cam consisted of a single element it might be necessary to provide a relatively large number of cams in order that cams of different shapes might be placed upon the shaft 26'.

Stop arms 130, which are located between the edges of the cams 100, 101, 110, and 122 and the opposing cams upon the shaft 26', are pivoted at their outer ends upon a stationary rod 131,

the said rod being mounted at its opposite ends in holes provided in the plates 1 and 20. These stop arms are retained in spaced relation to each other by spacing sleeves upon the said rod 131 and between adjoining arms, the outermost of said arms being retained in place by sleeves fastened upon the said rod and seated against the outer sides thereof. These spacing and retaining sleeves are not shown in the drawings because such sleeves are in common use for the purpose for which they are employed in this construction. The inner ends of the arms 130 terminate in cross head portions the lower ends of which are provided with lateral projections 132, 133, 134, and 135 which respectively contact with the outer edges of the cam discs 100, 101, 110, and 122. Such contact is due to the force of gravity acting upon the said arms 130. The opposite ends of the heads project above the top edges of the arms 130 and constitute stop projections 136, 137, 138 and 139 which cooperate respectively with the stop projections 77, 78, 80, and 81 previously referred to.

In the construction as illustrated the stop 136 is in engagement with the stop projection 77 at which times the two left hand cams upon the shaft 26, having reference to Figs. 10 and 18, are in position to permit the movable contacts 27 and 28 to contact with the stationary contacts 39 and 40. At such time the remaining switch actuating cams are in position to hold the movable switch contacts out of contact with the stationary contacts. It will be apparent upon reference to Fig. 18 that the switches will remain in that position until the timing cam 100 shall have rotated sufficiently to locate the shoulder 123 in position to release the inner end of the stop arm 130 to permit descending or falling movement thereof to release the stop 136 from the stop projection 77. Upon such release the switch cam unit will rotate under the influence of the coiled spring 95 in a counterclockwise direction until the stop projection 78 contacts with the stop 137, at which time the movable contacts 28 and 29 will be in contact with the stationary contacts 40 and 41. Upon continued rotation of the timing cam unit the shoulder at 124 will permit the descent of the stop 137 to release the stop projection 78 to permit further movement of the cam unit for operating the switches. The further rotation of the switch cam unit is limited by contact of the contact projection 80 with the stop 138. When the contact projection 80 is in engagement with the stop 138 the cams which are associated with the stop projections 79 and 80 are in position to permit the contacts 30 and 31 to contact with the stationary contacts 42 and 43. A further rotation of the timing cam unit permits the stop 138 to release the stop projection 80 whereupon the switch actuating cam unit continues its rotation until the stop projection 81 contacts with the stop 139. While the stop projection 81 is in contact with the stop 139 the cams which control the contacts 31 and 32 are in position to permit the latter to contact with the stationary contacts 43 and 44. Further rotation of the timing cam unit releases the stop 139 from the stop projection 81 at which time the cycle is completed and a repetition of a similar cycle is begun. In other words, the next following position is that shown in Figs. 10 and 18.

If it be assumed that the contact switches 27, 29 and 31 respectively control circuits including green, amber and red lights for controlling traffic upon a main highway at a crossing, and that the

contacts 28, 30 and 32 control circuits including red, green and amber lights upon a cross street, it will be seen that the said contacts are so controlled as to provide simultaneously a green light for the main street and a red light for the cross street; that the red light upon the cross street continues for a period after the extinguishment of the green light upon the main street and during such continuation of the red light an amber light appears upon the main street; that succeeding this condition green and red lights appear simultaneously upon the cross and main streets respectively; and that the red light upon the main street continues for a short period after the extinguishment of the green light upon the cross street during which period of continuation of the red light upon the main street an amber light appears upon the cross street. This completes a cycle which is immediately followed by another cycle.

It will be apparent that if relative adjustment of the cams of the timing cam unit is effected the relative times of release of the stop projections 77, 78, 80, and 81 likewise will be changed. It may be noted that by adjusting the cam 100 from a position selected as an initial or zero position in clockwise direction the release of the stop projection 77 will be effected at an earlier period in the cycle movement to permit rotation of the cam switch unit. Such movement, as has been described previously, will operate to open the switch 27. However, the adjoining cam for operating the contact 28 is of such shape that said contact is not opened, but the cam for operating the contact 29 is of such shape that the latter is permitted to close. The shoulders 123 and 124 are so related to each other that the stop 137 is held in engagement with the stop projection 78 but a short while during which period the contact 29 is in contact with the stationary contact 41. Upon release of the stop 137 the cam switch actuating unit rotates until it is stopped by the engagement of the stop projection 80 with the stop 138, at which time the contacts 30 and 31 are in closed position as described. An adjustment of the cam 110 in a clockwise direction will permit a descending or falling movement of the stop 138 at an earlier time in the cycle to thereby release the stop projection 80. Such release permits rotation of the cam unit for actuating the movable switches to cause opening movement of the switch contact 30 and closing movement of the switch contact 32, the latter remaining closed only for a short period until the cam 122 moves into position to release the stop 139.

If relative adjustment of the cams 100 and 101 be effected, as it may be, so as to position the shoulders 123 and 124 in the same plane radially of the axis of the timing cam shaft, and if at the same time the edges of the shoulders 125 and 126 be positioned in the same plane but extending in the opposite direction, it will be found that the pairs of movable contacts 27 and 28, and 30 and 31, respectively, will be moved alternately and simultaneously into closed and opened positions. In other words, when the contacts 27 and 28 are closed the contacts 30 and 31 are opened, and vice versa. When so adjusted the contacts 29 and 32 are ineffective in the controlling of the circuits in which they are included.

For the purpose of effecting relative adjustments of the cams of the timing cam unit I have provided an adjusting and controlling means comprising a disc 140 which is mounted on the right hand outer end of the tubular shaft or

sleeve 113, an arm 141 which is connected to the outer end of the tubular shaft or sleeve 105, a quadrant 142 which is connected to the outer end of the tubular shaft 102, and an arm 143 which is secured to the outer end of the shaft 99. The disc 140 is provided with slots 145 and 146 which are of arc shape. The arm 141, the quadrant 142 and the arm 143 are rotatably adjustable relatively to the disc 140 and to each other. The arm 141 is adapted to be adjusted through an angle corresponding to the length of the arc 145 and may be fastened in any position to which it may be adjusted by means of a binding post and nut 150. The quadrant 142 also is adjustable through an angle corresponding to the length of the slot 146 and is adapted to be held in any position to which it may be adjusted by means of a binding nut and bolt 151. The arm 143 likewise is rotatably adjustable through an angle corresponding to the length of an arc 152 provided in the quadrant 142, and may be held in any position to which it may be adjusted by the binding nut and bolt 152'.

The front or outer face of the disc 140 is provided with radial lines 153 which divide the same into spaces of the width equal to one percent. of the circumferential portion of the said surface. Likewise the outer edge portion of the outer surface of the quadrant 140 is divided into spaces each constituting approximately one percent. of the angle between the starting or initial point 154 thereof and the point indicated at 155. The disc 140 is provided on opposite sides of a line corresponding to the radial zero line 156 with a green colored portion 157 and a red colored portion 158. The quadrant 152 is provided with like colored portions 159 and 160. By loosening the binding nut at 151 and adjusting the quadrant toward and from the green portion 157, which causes adjustment simultaneously of both the timing disc cams 100 and 101, an adjustment of the periods of control of the contacts 27, 28 and 30 and 31 is effected.

For example, if the arm 141 be adjusted into position with the arrow 160' thereon in alinement with the zero line 156 and the arm 143 also adjusted into position with the arrow 161 thereon in alinement with the line of division between the colored sections or portions 159 and 160, and if then the quadrant 142 be adjusted into position with the line of division between the said portions 159 and 160 in alinement with the divisional line 50 of the several divisional lines numbered 5, 10, 15, etc., then the pairs of contacts 27 and 28 and 30 and 31 will be opened and closed alternately and the periods during which they are opened will be equal to those during which they are closed.

If the quadrant be adjusted so as to move the green portion 159 thereon toward or from the green portion 157 upon the quadrant the period during which the couple of contacts 27 and 28 will remain closed will be varied with a corresponding reverse variation of the period during which the couple of contacts 30 and 31 will remain opened or closed. If the quadrant is moved in a counter-clockwise direction so as to increase the space between the green portions 157 and 159 the period during which the contacts 27 and 28 will remain closed is increased while the period during which the couple of contacts 30 and 31 will remain closed will be decreased. For example, if the quadrant 142 be adjusted so that the line of division between the colored portions 159 and 160 is in alinement with the line of the divi-

sional number 70 upon the disc 140 then the disc will rotate through seventy percent. of a complete rotation while the contacts 27 and 28 are closed and will rotate through only thirty percent. of its complete cycle of rotation while the contacts 30 and 31 are closed.

If the arm 141 be adjusted from the zero line 156 into alinement with the divisional percentage line 95, as shown in Fig. 1, with the quadrant 142 and the arm 143 in the positions in which they are shown in Fig. 1 of the drawings, and the mechanism operated to rotate the disc 140 forwardly in a clockwise direction, it will be found that upon arrival of the point 161 upon the arm 143 in alinement with the arrow 163, which may be regarded as the initial or starting point of the cycle, the timing cam 100 will be released to permit rotation of the switch cam unit through a short distance to open the contact 27 and to permit closing of the contact 29. The rotation of the switch cam unit upon release of the stop 136 is interrupted by the engagement of the stop 137 with the stop projection 78. That happens after but a very short rotation of the switch cam unit. The switch cam unit is held against rotation for a short period, namely, that during which the disc 140 and the quadrant 142 rotate through the angle measured by the distance between the point 161 and the divisional line between the colored portions 159 and 160. When these parts have rotated through that distance then the stop 137 is disengaged from the stop projection 78 whereupon the switch cam unit rotates through a further distance or step to cause opening of the contacts 28 and 29 and to cause or permit closing of the contacts 30 and 31. During the latter period the switch cam unit is held in position by the engagement of the stop 138 with the stop projection 80. These two contacts 30 and 31 remain in closed position until the arm 141 again arrives in alinement with the arrow 163 at which point the stop 138 is released from the stop projection 80 to permit rotation of the switch cam unit through a short distance until the stop projection 81 engages the stop 139. The switch cam unit is held against rotation by the stop 139 during the period of the movement of the disc from a position in which the arm and the percentage divisional line 95 are in alinement with the arrow 163 until the zero line 156 upon the disc is moved into alinement with the said arrow 163. At the latter point the stop 139 releases the stop projection 81 so as to permit rotation of the switch cam unit until the stop projection 77 engages the stop 136 at which point the contacts 27 and 28 are again closed.

If it be understood that the contacts 29 and 32 control the amber or caution lights on the main and the cross streets, respectively, of a crossing it will be apparent that the amber light for the main street will remain lighted for a ten percent. period during which the contact 28 is closed, which may be understood as controlling the red light of the cross street; and it also will be understood that the contact 32 controls the amber or caution light of the cross street; that it will remain lighted for a period corresponding to five percent. of the total cycle of operation; and that during that period, that is, during the period that the contact 32 is in closed position, the contact 31 also will be in closed position so that for that short period of time the red light upon the main street will also be lighted.

It will be apparent from a study of the specification and the drawings that the adjusting means

shown in Figs. 1, 10, and 18 enables the relative adjustment and positioning of the cams of the timing cam unit in a manner to obtain and effect the closing and opening of the contacts 27 to 32 inclusive at such intervals and in such relation to each other as may be desired. By reference to the divisional lines upon the disc 140 and upon the quadrant 142 it will be seen that means is provided whereby the person having charge of the machine may adjust the cams of the timing cam unit with accuracy and certainty to obtain the precise and exact result desired. By adjusting the quadrant 142 so as to vary the distance between the dividing line between the green and red colored portions 159 and 160 and the zero line 156 upon the disc 140 a variation of the periods during which the contacts 27 and 28 are held in closed and open position may be effected, and by adjusting the arms 141 and 143 the periods of opening and closing the contacts 32 and 29 respectively may be controlled.

If it should be desired to open and close any one of the switch contacts 27, 28, etc., twice during a cycle of operation, such opening and closing may be accomplished by the employment of a double cam as one of the cams of the switch cam unit instead of a cam of the shape as shown. Such a double cam is illustrated in Fig. 20 of the drawings and it will be noted that it is provided with oppositely disposed depressions 164 and 165. It will be apparent that the presence of these depressions will permit descending movement of an arm 33 to permit movement of the contact carried thereby into contact relation with a stationary contact. In the case of a five period operation it may be found desirable to cause the contact 28 to be opened and closed twice during a cycle, in which event a double cam such as is shown in Fig. 20 should be substituted for a cam of the shape illustrated in Fig. 18 for operating said switch, and in the event that it also should be desired to cause the opening twice not only of the contact 28 but also of the contact 31 during a cycle a second double cam should be embodied in the switch cam unit for causing two operations of the said switch 31 during each cycle of operation of the machine.

In case it should be desired to change the machine from a four period to a five or six period controlling means additional timing cams should be placed upon the shafts 99 and 105 and additional stop arms 130 associated therewith to provide stops for cooperation with the stop projections 76 and 79 which are associated with the first and fourth cams, reading from the left in Fig. 18, of the cam unit for actuating the movable switch contact. It will be apparent that by the addition of these two timing cams in association with stops intermediate the same and the projections 76 and 79 the cam unit may be held against rotation an increased number of times during a cycle of operation.

Reference previously has been made herein to the fact that mechanical means is provided in the construction as illustrated for a speeding up of the operation of the mechanism. The means provided by me for that purpose now will be described. To that end the gear 14 is mounted upon a stub shaft or projection 166 which is supported upon one end of a plate 167 which may be described generally as of segmental shape. The said plate is pivoted at a point near the center of its length upon the reduced projecting end 167' of the bearing for the shaft 12. The other or opposite end of the said plate is provided with

a slot 168 of arc shape through which a clamping or fastening screw 169 extends. The said screw has screw threaded engagement with the plate 20 of the frame of the machine and interposed between the head thereof and the said plate 167 is a washer 169'. By loosening the screw 169 the plate 167 may be turned or rotated about the shaft 12 so as to move the stub shaft or projection 166 toward and from the gear 15. By thus changing or varying the distance of the stub shaft 166 from the gear 15 it will be apparent that the gear 15 may be removed and another gear of different size and having a different number of teeth substituted therefor. By substituting for the gear 15 a smaller gear the speed of rotation of the shaft 16 will be increased. On the other hand, if a gear larger than the gear 15 as shown be substituted for the latter the speed of rotation of the shaft 16 will be decreased. Obviously a variation of the speed of rotation of the shaft 16 will cause a variation in the speed of rotation of the cam units of the structure previously referred to herein and described.

As already indicated, the machine embodying my invention has been designed primarily for use in the controlling of the green, red and amber lights employed at the crossings of highways and streets for controlling the flow of traffic thereon and the same has been described with such use in view, but it should be understood that the machine may be designed for the purpose of use in other relations and in other arts.

Although I have assumed that the device as illustrated is to be used in the controlling of traffic signal lights yet I have not illustrated the circuits leading from the said device to the said lights because the arrangements of such circuits are well known and are not novel with me. My invention resides in the mechanism and means for controlling, as above described, the opening and closing of the switch contacts and for the regulation and controlling of periods during which such contacts may be held either in closed or in opened position.

To increase further the utility and advantage of the device embodying my invention I have associated with and provided therein means whereby a switch may be opened and closed continuously in order to cause, for example, the flashing of a light at or in the neighborhood of a crossing or a dangerous point of other kind upon a highway, street or the like. The means employed by me for that purpose comprises a short bar 170 connected at a point intermediate its ends to the outer end of the shaft 12. Contact rollers 171 of insulating material are mounted upon the outer ends of the said bar. Upon rotation of the shaft 12 the bar secured thereto rotates therewith. Such rotation causes revolution of the rollers 171 about the axis of the shaft 12 and once during each revolution of each roller 171 it contacts with the outer projecting end of a spring metal strip 172 rigidly supported at one end as indicated at 173. The strip 172 is provided with a contact 174 a short distance from its outer movable end which is adapted to contact with a contact 175 supported upon the outer end of a spring metal spring 176 also supported at its outer end as indicated at 177. The outer ends of the strips 172 and 176 are supported upon a bracket 178 secured upon the frame member of the machine. Inward movement of the strip 176 toward the strip 172 is limited by a relatively stiff metal strip 179. The metal strips 176 and 179, the metal strip 172 and the bracket

178 are insulated from each other by insulating means indicated at 180. The strips 172 and 176 are connected with a circuit portions of which are shown at 181. This circuit may include a caution light, a red light or a light of any other character which may be desired.

The continuous flashing of a light which is associated with the traffic signal lights creates a condition affording the highest possible degree of protection to traffic at a highway or street crossing.

It will be seen that by my invention I have provided a relatively simple construction of machine or apparatus for the controlling of a plurality of electric contacts and for causing them to be opened and closed in such sequence and in such relation to each other as may be necessary to produce a desired result, such for example, as the lighting and the extinguishment successively and in desired sequence of a plurality of electric lights.

It also will be seen that I have provided means whereby a person desiring to obtain a certain result may do so with accuracy and with great facility merely by the adjustment of a plurality of arms or other adjusting means located upon the machine so that they are readily accessible and available, the said arms or other adjusting means being associated with means which will indicate the exact distance through which the adjusting means may be moved and the relation of the movement of one adjusting element to another or other adjusting elements.

It is to be noted that in the construction of the machine embodying the invention means is provided for effecting rapid make and break, that is, closing and opening, of the electric contacts, thereby reducing arcing and consequent radio interference, and also resulting in increasing the life of the contact points.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In electric switch control means, the combination of a plurality of independently actuated electric switches, a rotatable cam unit including a plurality of cams for actuating said switches successively and at intervals, a power storing means for causing rotation of the said cam unit, separate means associated with each cam for controlling the rotation of said unit, means for actuating said separate means in unison, and means for adjusting said separate means relatively to each other to vary the time interval between the actuation of successive switches.

2. In electric switch control means, the combination of a plurality of electric switches each comprising a stationary contact and a movable contact, a plurality of cams for actuating the movable contacts, each cam including a plurality of parts adjustable relatively to each other to change the shape thereof and thus vary the periods of engagement of the respective stationary contacts and movable contacts, means for rotatably supporting the said cams, means for causing rotation of said supporting means, and means for controlling the rotation of said supporting means to thereby control the rotative movement of the said cams.

3. In electric switch control means, the combination of a plurality of independently actuated electric switches, a plurality of separate cams for actuating said switches, rotatable means for supporting said cams, power storing means acting upon the said rotatable supporting means for causing rotation thereof, separate means asso-

ciated with each cam for holding the said rotatable supporting means against rotation, independent means for releasing each of said holding means at intervals to permit rotation of the said supporting means at intervals, means for actuating said independent means in unison, and means for adjusting said independent means relatively to each other to vary the time interval between the actuation of successive switches.

4. In electric switch control means, the combination of a plurality of independently actuated switches, a plurality of separate means for actuating said switches, a rotatable support for said means, means for the storage of power having connection with the said rotatable support and tending to cause rotation thereof, a plurality of stop devices carried by said support and independently associated with said separate means, stop means for engaging and releasing successively each of the said stop devices for permitting rotation of the said support at intervals to cause rotation of the said switch actuating means for actuating the said switches, separate continuously rotating means for actuating said stop means in succession, and means for adjusting said separate continuously rotating means relatively to each other to vary the time interval between the actuation of successive switches.

5. In electric switch control means, the combination of a plurality of independently movable switch contacts, a plurality of separate means for actuating said contacts successively and at intervals, a rotatable support for supporting the said switch contact actuating means, a coiled spring having connection at one end with said support, rotatable means having connection with the opposite end of said spring for winding the same up and storing power therein, a plurality of stops mounted upon the said support and independently associated with said separate means, stop means for successively releasing and engaging each of the said stops for permitting the said spring to cause rotation of the said support at intervals to actuate the said switch contacts successively and at intervals, separate continuously rotating means for actuating said stop means in succession, and means for adjusting said separate continuously rotating means relatively to each other to vary the time interval between the actuation of successive switches.

6. In electric switch control means, the combination of a plurality of movable switch contacts, a plurality of cams for actuating said contacts, each of said cams including a plurality of parts rotatably adjustable with respect to each other to change the shapes of the said cams, a support for the said cams, stop projections mounted upon the said support in adjoining relation to the respective cams, stops movable into and out of position to engage and disengage the said stop projections, and means for actuating said stops to effect movement thereof into and out of positions to engage and disengage the said stop projections.

7. In electric switch control means, the combination of a plurality of independently actuated electric switches, a switch cam unit including a cam associated with each of said switches for actuating the same, a timing cam unit including a separate cam associated with each switch cam, means interposed between the said timing cam unit and the said switch cam unit for inde-

pendently controlling the operation of each cam of the said switch cam unit, and means for effecting relative adjustment of the timing cams with respect to each other to vary the time interval between the actuation of successive switches.

8. In electric switch control means, the combination of a plurality of independently movable switch contacts, a switch cam unit having a separate cam therein for actuating each of said contacts, means for rotatably supporting said switch cam unit, power storage means tending to cause rotation of the said switch cam unit, a timing cam unit including a plurality of cams each of which is independently associated with one of the switch cams, a stop interposed between each timing cam and the corresponding switch cam, the said stops being adapted to engage and release parts of the switch cam unit to hold the same against rotation and to permit rotation thereof, means for rotating the timing cams in unison, and means for effecting relative adjustment of the timing cams with respect to each other to vary the time interval between the actuation of successive switches.

9. In electric switch control means, the combination of a plurality of independently actuated electric switches, a rotatable switch cam unit having separate cams for actuating each of said switches to open and close the same, power storage means tending to cause rotation of the said rotatable switch cam unit in one direction, controllable means associated with each of said cams for permitting rotation of said switch cam unit at intervals under the influence of said power storage means, continuously operating means for actuating said controllable means in unison, and means for effecting relative adjustment of said controllable means with respect to each other to vary the time interval between the actuation of successive switches.

10. In electric switch control means, the combination of a plurality of independently actuated electric switches, a cam for actuating each of said switches to open and close the same, a rotatable support for the said cams, a timing cam unit including a separate cam for each switch cam, and a stop interposed between each of the said timing cams and the said rotatable support, the said stops being actuated by the said timing cams and moved thereby into and out of positions to control the rotation of the said support.

11. In electric switch control means, the combination of a plurality of independently actuated electric switches, a switch cam unit having separate cams therein for actuating each of said switches, means for rotatably supporting said unit, yielding power storage means tending to cause rotation of said unit in one direction, a timing cam associated with each switch cam, and a stop interposed between each switch cam and the corresponding timing cam and movable by the latter into and out of position to engage part of said unit to control the rotation thereof.

12. In electric switch control means, the combination of a plurality of independently actuated electric switches, a switch cam unit having separate cams therein for actuating each of said switches to open and close the same, means for rotatably supporting said unit, yielding power storage means having connection with said unit and tending to cause rotation thereof in one direction, means for causing the storage of power in the said power storage means, a plurality of rotatable cams supported in cooperative

relation to the said switch cam unit and having separate timing cams cooperating with each switch cam, and a movable stop interposed between each switch cam and the corresponding timing cams and being actuated by the latter into and out of position to engage part of the said switch cam unit to control the rotation thereof.

13. In an electric switch control means, the combination of a plurality of electric switches, a switch cam unit including a plurality of cams for actuating the said switches to open and close the same, means for rotatably supporting the said switch cam unit, means tending to cause rotation of the said switch cam unit in one direction, a timing cam unit including a plurality of timing cams, means for manually effecting relative adjustment of the said timing cams, and stop devices controlled by the said timing cams for controlling the rotation of the said switch cam unit.

14. In electric switch control means, the combination of a plurality of electric switches, a switch cam unit for actuating said switches to open and close the same, means for rotatably supporting said switch cam unit, yielding power storage means tending to cause rotation of said switch cam unit in one direction, a timing cam unit including a plurality of timing cams, said timing cam unit being rotatable, stops interposed between the said switch cam unit and the said timing cams and actuated by the latter to control the rotative movements of the said switch cam unit, and means for adjusting the said timing cams into predetermined positions to thereby control the action of the said stops.

15. In electric switch control means, the combination of a plurality of electric switches, a switch cam unit including a plurality of cams for actuating said switches to open and close the same, means for rotatably supporting the said switch cam unit, a timing cam unit including a plurality of timing cams, stops interposed between the said switch cam unit and the said timing cams and adapted to engage portions of the said switch cam unit to hold the same against rotation, and means for relatively adjusting the said timing cams to thereby control the periods during which the said stops are in engagement with portions of the said switch cam unit for holding it against rotation.

16. In electric switch control means, the combination of a plurality of electric switches, a switch cam unit including a plurality of cams for actuating the said switches to open and close the same, means for rotatably supporting said switch cam unit, yielding means for causing rotation of said switch cam unit, a timing cam unit including a plurality of timing cams, stops interposed between the said switch cam unit and the said timing cams and adapted to be moved by the latter into positions to engage parts of the said switch cam unit to hold the same against rotation, a plurality of supports for the said timing cams, said supports being rotatable relatively to each other in order to effect relative rotative adjustment of the said timing cams to vary the periods during which the said stops are held in position to engage parts of the said switch cam unit to hold the same against rotation, and means for adjusting the said relatively rotatable supports into predetermined positions.

17. In electric switch control means, the combination of a plurality of independently actuated electric switches, means for actuating said switches for causing opening and closing move-

ments thereof, a timing cam unit including a separate timing cam associated with each switch, means interposed between each of the said timing cams and the said switch actuating means for controlling the movements of the latter, the said interposed means being controlled by the said timing cams, and means for adjusting said timing cams relatively to each other to vary the time interval between the actuation of successive switches.

18. In electric switch control means, the combination of a plurality of independently actuated electric switches, a timing cam unit including a separate cam associated with each switch, means interposed between the said timing cams and the said switches for actuating the said switches to open and close the same, the said interposed means being controlled by the said timing cams, and means for adjusting said timing cams relatively to each other to vary the time interval between the actuation of successive switches.

19. In electric switch control means, the combination of a plurality of electric switches, a timing cam unit including a plurality of cams, means for adjusting said cams relatively to each other to vary the time interval between the actuation of successive switches, means for causing said cams to rotate in unison, and means interposed between the said cams and the said switches for actuating the latter to cause opening and closing movements thereof, the said last named means being controlled by the said timing cams.

20. In electric switch control means, the combination of a plurality of electric switches, a timing cam unit including a plurality of cams, a plurality of concentric shafts for supporting the said timing cams, means for causing relative adjustment of the said shafts for effecting relative adjustments of the said timing cams, means for fastening the said concentric shafts together, means for causing the rotation thereof and of the said timing cams, and means interposed between the said switches and the said timing cams and controlled by the latter for actuating the said switches to open and close the same.

21. In electric switch control means, the combination of a plurality of movable switch contacts, a timing cam unit including a plurality of cams, a plurality of concentric shafts for supporting said timing cams, a disc connected to the said shafts, a plurality of arms connected respectively to different shafts, means for adjustably connecting said arms to the said disc, relative adjustments of said arms causing relative adjustments of the said timing cams, visual means for indicating the extent of adjustment of the said timing cams, and means interposed between the said movable switch contacts and the said timing cams and controlled by the latter for actuating the said movable switch contacts to open and close the same.

22. In electric switch control means, the combination of a plurality of movable switch contacts, a timing cam unit comprising a plurality of timing cams, a plurality of concentric shafts for supporting said timing cams, said shafts being relatively rotatably adjustable, a sleeve interposed between two of said concentric shafts, means for connecting said concentric shafts together, a disc mounted upon one end of the said sleeve, arms connected to certain of the said shafts and having adjustable connection with the said disc, visual means for indicating the extent of adjustment of the said arms relatively to the said disc, the adjustment of said arms causing adjustment of the said shafts to thereby adjust the said

timing cams, means for causing rotation of the said concentric shafts, and means interposed between the said movable switch contacts and the said timing cams and controlled by the latter for actuating the said switch contacts to open and close the same.

23. In electric switch control means, the combination of a plurality of electric switches, a timing cam unit including a plurality of timing cams and a plurality of concentric shafts for supporting said cams, said shafts being relatively rotatably adjustable, means for causing relative adjustment of the said concentric shafts and of the timing cams carried thereby, means for fastening the said concentric shafts together, means for causing rotation simultaneously of all of the said shafts, and means interposed between the said switches and the said timing cams for actuating the said switches to open and close the same, the said means being controlled by the said timing cams.

24. In electric switch control means, the combination of a plurality of switches, a switch cam unit for actuating the said switches, means for rotatably supporting said switch cam unit, a timing cam unit including a plurality of timing cams, a plurality of concentric shafts for supporting said timing cams, means for causing relative rotative adjustment of the said shafts to cause corresponding adjustment of the said timing cams, means for securing the said concentric shafts together to cause simultaneous rotation thereof, a gear mounted upon one of said shafts, means for applying power to the said gear to drive the same, means interposed between the said gear and the said switch cam unit for applying power to the latter to cause rotation thereof, and means interposed between the said switch cam unit and the said timing cams for controlling the rotation of the said switch cam unit, the said interposed means being controlled by the said timing cams.

25. In electric switch control means, the combination of a plurality of pairs of electrical contacts for controlling a plurality of electric circuits, each pair of contacts including a movable contact, means for actuating the said movable contacts at predetermined times and in predetermined sequence, said means including an intermittently rotatable member for actuating the said movable contacts, a continuously rotating member in operative relation to the said intermittently rotatable member, and means intermediate the said two members and controlled by the said continuously rotating member and thereby caused to control the intermittent movements of the said intermittently rotatable member.

26. In electric switch control means, the combination of a plurality of electric switches, intermittently movable means for actuating said switches to open and close the same, continuously rotating means, connections between the said

continuously rotating means and the switch actuating means for causing actuation of the latter, means interposed between the said continuously rotating means and the said switch actuating means for controlling the movements of the latter, power means, and connections between said power means and the said continuously rotating means for causing continuous rotation of the latter, the said connections including means whereby change in the speed of rotation of the said continuously rotating means may be effected.

27. In electric switch control means, the combination of a plurality of switches each including a movable contact member, actuating means for causing opening and closing movements of the said movable contact members in timed relation to each other, power means, gear connections interposed between the said power means and the said switch actuating means for actuating the latter, the said gear connections including a support for one of the gears of the said connection which is revoluble about an axis for varying its position with respect to another gear of the said connection to thereby permit the replacement of the gear of one dimension by a gear of a different dimension to thereby change the speed of operation of the said switch actuating means.

28. In electric switch control means, the combination of a plurality of electric switches each including a movable switch member, yielding means tending to hold the said movable switch members in closed position, intermittently rotatable means for actuating said movable switch members, the said intermittently rotatable means including means for actuating the said movable switch members in timed relation to each other, a continuously rotatable member, means for causing continuous rotation of said member, and means interposed between the said continuously rotatable member and controlled thereby and the said intermittently rotatable member for controlling the periods of rotation of the said intermittently rotatable member.

29. In an electric switch control means, the combination of a plurality of switches each including a movable switch contact, an intermittently rotatable switch cam unit for actuating the said movable switch contacts for opening and closing the said switches, the said intermittently rotatable switch cam unit including means for causing a plurality of opening and closing movements during each complete rotation of the said intermittently rotatable unit, a continuously rotatable unit, means for causing continuous rotation of said unit, and means interposed between said continuously rotatable unit and the said intermittently rotatable unit and controlled by the said continuously rotatable unit for controlling the rotation of the said intermittently rotatable unit.

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