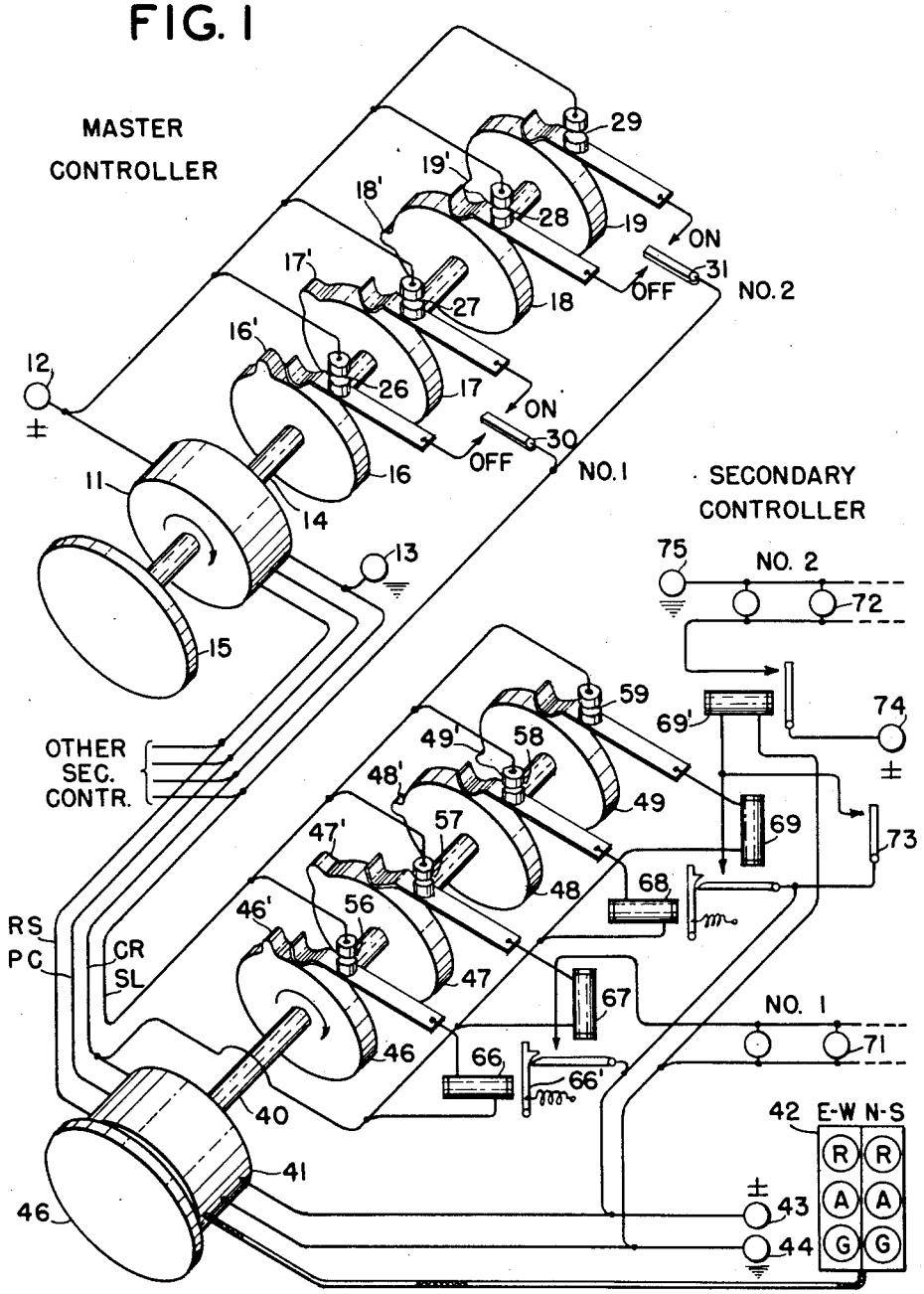
Sept. 9, 1952 J. O'D. SHEPHERD 2,610,239

TRAFFIC SIGNAL AND STREET LIGHT CONTROL SYSTEM

Filed Sept. 7, 1948 4 Sheets-Sheet 1

FIG. 1



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TRAFFIC SIGNAL AND STREET LIGHT CONTROL SYSTEM

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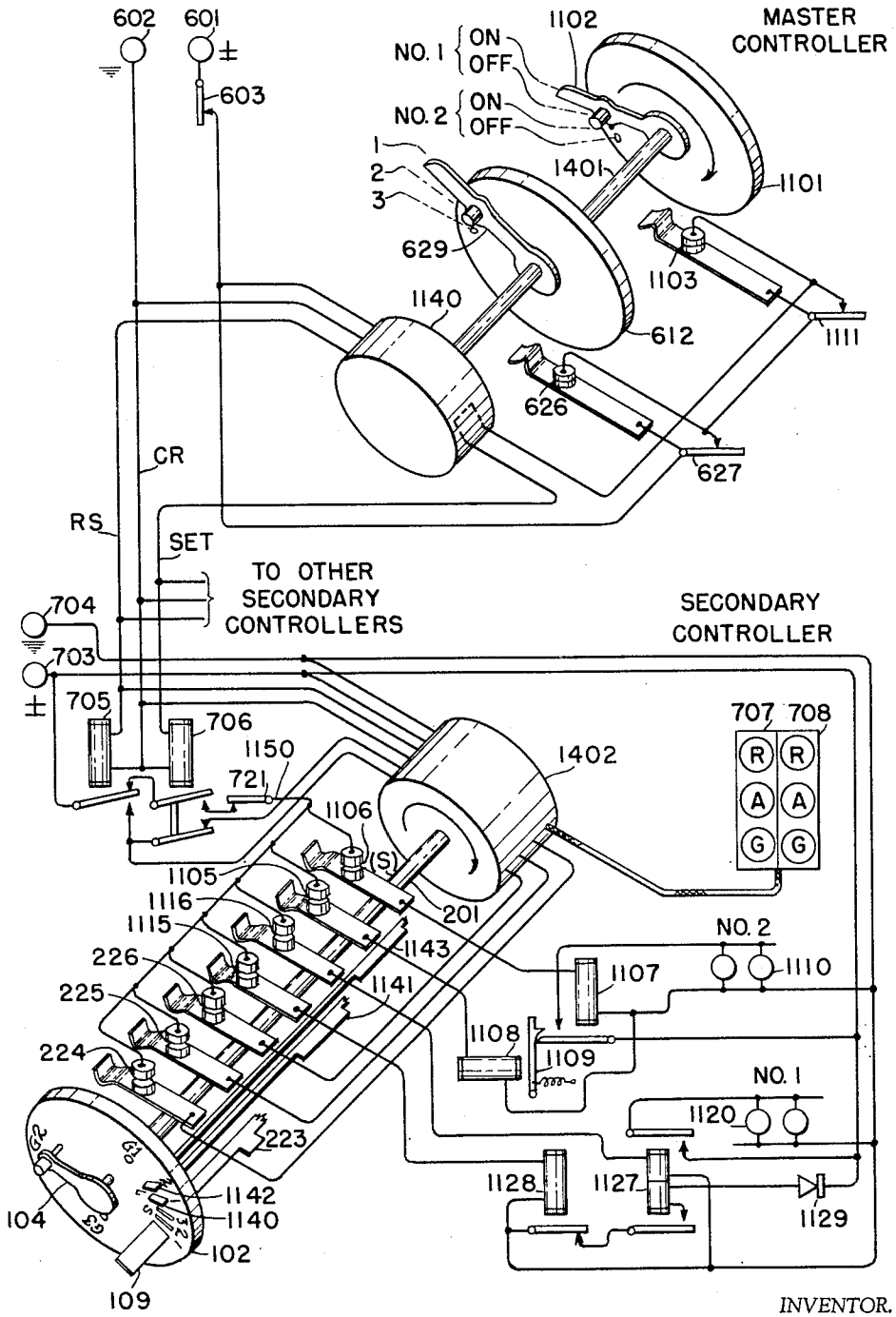

FIG. 2

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TRAFFIC SIGNAL AND STREET LIGHT CONTROL SYSTEM

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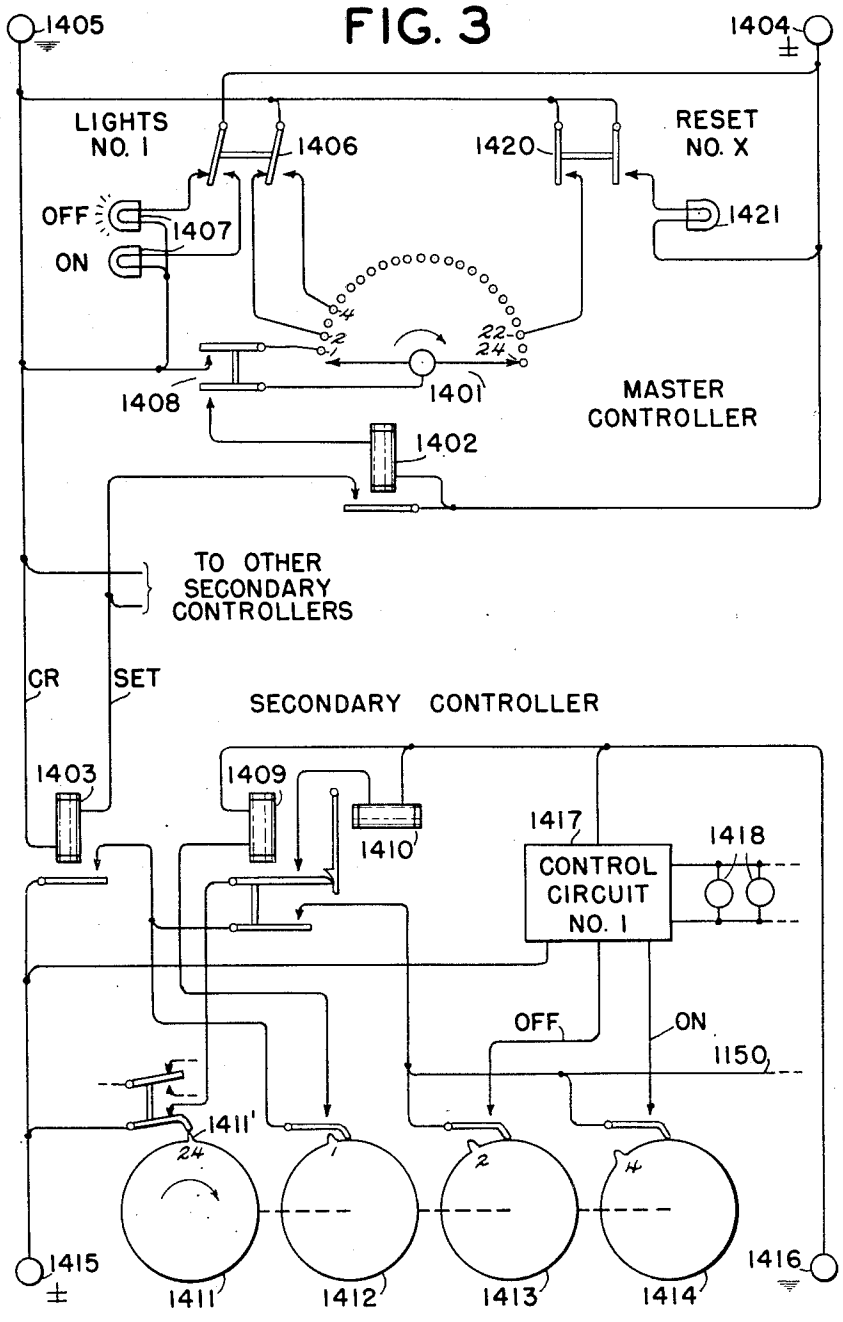
FIG. 3



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TRAFFIC SIGNAL AND STREET LIGHT CONTROL SYSTEM

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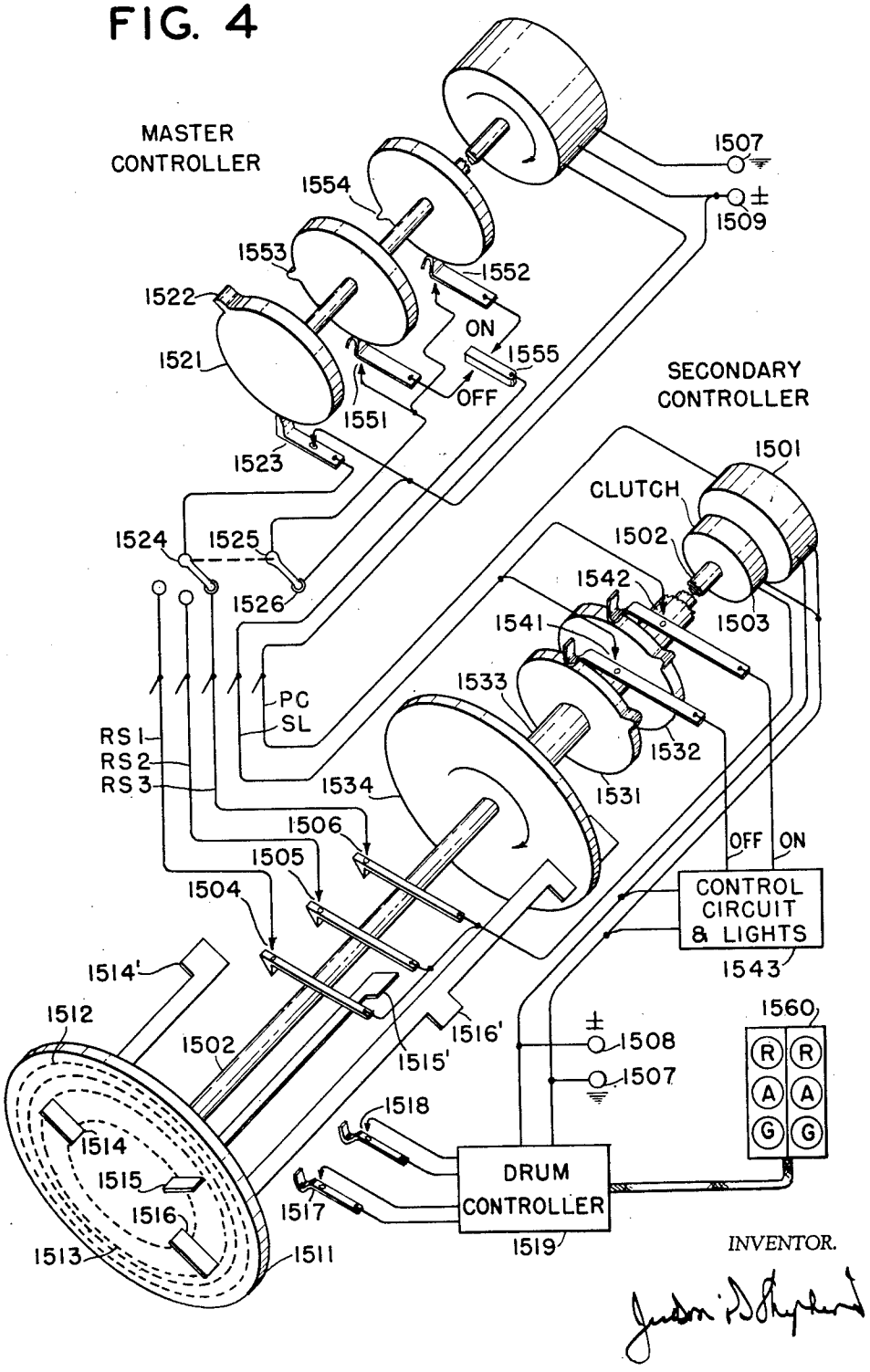
FIG. 4



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Patented Sept. 9, 1952

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UNITED STATES PATENT OFFICE

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TRAFFIC SIGNAL AND STREET LIGHT CONTROL SYSTEM

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Application September 7, 1948, Serial No. 48,045

8 Claims. (Cl. 177—352)

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This invention relates to street traffic signal control systems and, in particular, the turning on and off of street illumination lights from a central point as a part of such systems. This application is a continuation in part of my pending application Serial No. 357,022 filed September 16, 1940, now Patent No. 2,451,457, October 12, 1948.

The turning on and off of street illumination lights, including so-called white-way lights, is presently generally effected by one of several means. One arrangement is to extend the various light circuits back to a power station or substation where each circuit may be manually closed. This is employed particularly with light circuits in which the various lamps are connected in series, or individual lamps (or groups thereof) are supplied from the secondary of transformers, the primaries of which are connected in the series circuit from the power station. This arrangement requires a separate circuit for each group of independently controlled lights, which extends back to the power station.

A second commonly used arrangement, particularly for white-way lights, is to have such lamps in limited areas, such as one side of a street for one or more blocks, connected in multiple with a switch (usually in the base of one of the light standards) which is manually operable. This requires that each such switch be visited in the early evening by an operator to turn on the lights, and subsequently visited in order to turn off the lights, or two trips a day, seven days a week. This is costly from the standpoint of the salary of the operator and due to wastage of electricity, since it takes an operator some time to make his rounds and if the lights at the end of his tour are turned on at precisely the right time (as frequently designated by local law), it is inevitable that the remainder of the lights of the system will have been turned on too early.

A third arrangement employs a pilot or control circuit to actuate electro-magnetic circuit closers at the various points where power is supplied the lights of several circuits. This generally requires a plurality of such circuits extended from a central control point to the widely distributed circuit closers.

Still another scheme in use involves employment of a carrier current arrangement in which a relatively high carrier frequency is transmitted over the primary of the power distribution system. At each point where a street light circuit is supplied, there is provided a detector responsive to receipt of the carrier current to actuate a circuit closer for the light circuit. This arrangement is relatively costly and results in all lights served by each primary circuit being turned on simultaneously with the result of a sudden substantial load being added to the circuit, which may adversely affect the regulation of that circuit.

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The present invention discloses a new and improved means for administering city streets by providing street illumination light control by employment of a street traffic signal control system for this purpose, or certain of the elements of such a system.

Street traffic control systems with centralized control employ intersection or secondary controllers (frequently referred to as secondary timers) which control the signal lamps at the corresponding intersections. These secondary controllers, as they generally will be referred to, are connected in multiple to a master controller, or timer, by a few trunk conductors. These trunk conductors are employed to maintain the intersection controllers in synchronism and predetermined phase relation with respect to the master controller and, therefore, with respect to each other. In some systems, these trunk conductors provide for other functions, including total period control of the traffic cycle.

It is a general requirement of such centrally controlled systems that there shall be a shaft, dial or other element at each secondary controller which rotates or otherwise operates in synchronism with a corresponding element at the master controller. It is the common practice that such an element rotates once each traffic cycle and that at a certain point or time during each cycle, the phase relation of the element of each of the secondary controllers is checked with the master controller, with means to effect automatic restoration of synchronism of any secondary controller which may fall out of synchronism for any reason.

This invention makes available the existence of an element at each secondary controller of such systems which operates in synchronism with a corresponding element in the master controller to establish a synchronous distributor system for the selective operation of street illumination lights. Such a distributor system recognizes and makes use of the fact that a traffic cycle may be divided into a plurality of separate time intervals. At the master controller are provided (for illustration) two pairs of contacts for each street light circuit controlled, which are separately closed for a short interval at different particular

times during the traffic cycle; that is, at particular times during the cycle of the synchronous element thereat. One pair controls the turning on, and the other the turning off, of the street lights of its corresponding circuit. Corresponding arrangements are provided at the secondary controllers, so that there is closure thereat of one pair of contacts coincident with the closure of the first mentioned (lights on) contacts at the master controller and, likewise, the second pair of contacts are closed coincident with closure of the corresponding pair of contacts (lights off) at the master controller. At the secondary controller are two relays (or functionally similar elements), each connected to a corresponding one of the contact pairs, the first one adapted to close the street lighting circuit and the second adapted to open it. A conductor connects the contacts (through appropriate switch means) at the master controller with the aforesaid contacts at the intersection controllers. If it is desired to turn the street lights on, the first mentioned contacts at the master controller are connected to the aforementioned trunk conductor. When these contacts are closed, current is transmitted for a short interval to the secondary controllers, where the "on" contacts are coincidentally closed. This results in the relay operating which turns on the street lights, and this relay locks up, either electrically or by mechanical means, to maintain the lights on. When it is desired to turn the lights off, the second set of contacts at the master controller are connected to the trunk conductor. Subsequently, an impulse is transmitted to the secondary controllers to actuate the second (off) relay or magnet to release the operated "on" relay to cut off the street lights coincident with the closure of the second pair of contacts at the secondary controller.

Since there is a relatively long time interval in a traffic cycle (in the general order of a minute or longer), the time of the cycle may be divided up into a plurality of control intervals, with contacts closed at such separate intervals to provide the selective turning on and off of a plurality of different street lighting circuits.

It will be seen that the above described principle permits the selective operation of one or more street lighting circuits in conjunction with the street traffic control system by minor provisions. The cost and other difficulties involved with currently employed arrangements are thereby traversed in a simple and wholly practical manner.

It is a feature of this invention to provide means at the master controller to indicate visually the status (whether on or off) of remote street light circuits, and of the reset in which the traffic signal control system is operating.

It is also a feature to provide remote street light control with traffic control systems in which variable offset of the secondary controllers is effected from the master controller by changing the point at which the secondary controllers are resynchronized.

A still further feature is means to provide two short impulses or other circuit condition spaced at predetermined times or points during the traffic cycle in order to effect street light or signal reset control, with the portion of the cycle intervening between said impulses determining the street light circuit to be controlled and whether it is turned on or off, or the reset of the secondary controllers which is effected. By such use of two impulses, false operation of a street light circuit or reset is greatly minimized, particularly since it is disclosed that the points during the cycle of said impulses have such relationship with each other as practically to preclude accidental impulse conditions at the secondary controller having such relationship.

These and other features of the invention will be understood from the drawings and specification which follows.

In describing this invention, it will be understood that reference to street light circuit No. 1 (or No. 2), for example, may indicate either a circuit individual to a particular secondary controller or it may represent a class of circuits. By class of circuits is meant, for example, the circuits for street intersection illumination lights which burn all night and which may be controlled by a plurality of secondary controllers throughout the system, but which may be referred to herein as circuit No. 1, notwithstanding there being separate individual circuits with power supplied from a plurality of points.

Mention herein of "reset" may indicate any secondary controller function such as change in offset, discontinuance of traffic signal light display, and other functions as set out in my aforesaid prior patent.

This invention is set out by four figures of drawings which are essentially circuit schematics with the inclusion of representations of certain of the mechanical elements employed in connection therewith. The mechanical arrangements generally are expanded better to show their functional relationships.

Figure 1 shows the basic arrangement for selecting and controlling from a master controller either of two separate street light circuits through the agency of secondary controllers.

Figure 2 discloses street light control as employed in connection with the traffic signal control system of my aforesaid prior patent.

Figure 3 shows arrangements for controlling street lights and resetting traffic signals from a master controller with means at the latter to give indication of the status of operation of the secondary controllers, and means to protect the system from false operation.

Figure 4 discloses application of street light operation to secondary controllers of a traffic control system having arrangements for variable offset by changing the resynchronizing points of the secondary controllers.

FIGURE 1

Figure 1 is a general disclosure of this invention as employed with a traffic signal control system employing a shaft at the master controller and one at each secondary controller which rotate in synchronism and predetermined phase relation with respect to each other. This figure is limited in its details to the essential elements for disclosure of the invention since the details of the mechanism and circuit elements for actuating the signal lamps, for maintaining the controllers in synchronism, for total period control, and for other features of a traffic control system are well understood by those practiced in this art. Reference will be made later, however, to certain prior patents disclosing certain of the arrangements mentioned immediately above.

The master controller elements related to the functioning of the traffic signal control and maintenance of the intersection controllers in synchronism are generally designated 11. This

includes a driving motor supplied from power terminals 12 and 13. Once each traffic cycle the synchronism of the intersection controllers is checked by a circuit over trunk conductors RS (resynchronizing), actuated by controller elements 11. A common return trunk conductor CR (which may be the ground of the power system) is provided. Conductor PC (period control) is representative of one or more conductors which may be employed to control the total period of the traffic cycle by means included in representation 11.

A shaft 14 is provided upon which is mounted a master controller dial represented by 15 to provide traffic control functions or other purpose which is usually found in systems of this character. Shaft 14 is driven (at an adjustable speed, if desired) by the aforesaid motor once each cycle of the traffic system. Attached also to this shaft are four contact actuators represented by discs or dials 16, 17, 18 and 19. Each of these discs has an actuating shoulder or cam 16', 17', 18' and 19', respectively. Each of these cams is adapted to close an associated pair of contacts 26, 27, 28 and 29, respectively, each revolution of shaft 14. It is to be noted that the cams are displaced with respect to each other, so that contact pairs 26, 27, 28 and 29 are closed in sequence, and it is to be further observed that only one pair of contacts is closed at any time.

Figure 1 provides for the independent control of two separate street lighting circuits, generally designated No. 1 and No. 2. One of these circuits is controlled by cams 16' and 17' and their associated contact pairs 26 and 27, with cam 16' and contacts 26 being effective to control the turning off of the lights of circuit No. 1, and cam 17' and contacts 27 function to control the turning on of the lights of this circuit. Cams 18' and 19' with their associated contacts similarly control the lights of circuit No. 2.

The upper contacts of each pair of master controller contacts are connected to power terminal 12. The lower contacts 26 and 27 are connected to contacts of manually operable switch 30, and lower contacts 28 and 29 are similarly connected to switch 31. Each of these switches has a neutral position (as shown), and each may be actuated manually to close either of its associated switch contacts, and will remain in either of its three operative positions. The moving member of each of these switches is connected to trunk conductor SL (street light) which extends to the secondary controllers.

At each secondary controller are elements related to the functioning of the controller to actuate the lamp circuits for signals 42, maintenance of these controllers in synchronism with the master controller and provision of total period control, and these elements are generally designated 41. This representation includes a driving motor which may be supplied from local power terminals 43 and 44. A shaft 40 is driven by latter said motor in synchronism with, and predetermined fixed phase relation to, shaft 14 at the master controller. Attached to this shaft is dial 46, usually employed with controllers of this class to effect various control operations such as the establishment of the relative displays of "go" to the main and side streets. Since these functions may be variously provided as known to the art and since the particular method of providing them is not significant to the understanding of this invention, merely the dial 46 and the control elements 41 are generally designated.

Affixed to shaft 40 are four contact actuators represented by discs or dials 46, 47, 48 and 49. These have actuating cams 46', 47', 48' and 49' for contact pairs 56, 57, 58 and 59, respectively. This arrangement of discs, cams and contacts may be identical with those at the master controller. The upper one of each contact pair is connected to trunk conductor SL. The lower contact of pair 57 is connected to the winding of relay 67. With this relay operated, a circuit may be traced from power terminal 43, the armature and contact of relay 67 to street lighting circuit No. 1 having one or more street illumination lamps 71, to the other power terminal 44, causing the lamps of circuit No. 1 to be lighted. When relay 67 operates, it is mechanically locked operated with its contacts closed by means of latch 66'. This latch may be withdrawn to release relay 67 by energizing magnet 66, one side of the winding of which is connected to the lower contact of pair 56.

A corresponding arrangement is provided for lighting circuit No. 2, and includes an operating relay 69 which locks up when operated under control of a latch which may be withdrawn to release it by energizing magnet 68. One end of the winding of relay 69 is connected to the lower contact of pair 59 and an end of the winding of magnet 68 is connected to the lower contact of pair 58. The opposite ends of the windings of the two relays and the two magnets are connected to the common return conductor CR.

Street lighting circuits frequently carry relatively high currents or high voltages, and it may not be desirable or economical to control such circuits directly by means of small relays in the secondary controller housing, as is contemplated for relays 67 and 69. Lighting circuit No. 2 is shown controlled indirectly by relay 69 by employment of contactor 69' connected to the contacts of this relay. This contactor may be separately housed, as in the base of a street lighting standard or pole, and may be operated to complete an obvious circuit from separate power supply terminals 74 and 75 to a plurality of lamps 72. It is obvious that a series instead of a parallel lighting circuit may be similarly controlled. A separately manually operable switch 73 may be provided to turn on the street lamps by operating contactor 69' over an obvious circuit for testing for lamp outages or other purposes. Such a switch 73 may, as an alternative, be arranged to close directly lighting circuit No. 2 rather than to operate contactor 69', as shown.

Operation of Figure 1

Let it be assumed that it is desired to turn on the lights of lighting circuit No. 1. At the master controller, switch 30 is manually thrown to the right or "on" position. When cam 17' causes closure of contacts 27, a circuit may be traced from power terminal 12, contacts 27, switch 30 over trunk conductor SL. At each secondary controller, contacts 57 will be closed simultaneously with the closure of contacts 27 at the master controller, so the circuit extended over conductor SL may now be traced through closed contacts 57, the winding of relay 67, the common return trunk conductor CR to the other power terminal 13, thereby causing relay 67 to operate and to be latched in its operated condition to cause the lights of circuit No. 1 to be turned on. After a complete traffic cycle, or at least after contacts 27 have been closed, switch 30 may be restored to its neutral position since the lights of circuit

No. 1 will be maintained on due to relay 67 being latched operated. Switch 30 may, however, be left in its operated position, if desired, which results in the energization of relay 66 once each traffic cycle, but this is normally ineffective with relay 66 already latched in its operated position.

When it is later desired to turn off the lights of circuit No. 1, switch 30 may be moved to its left or "off" position. When contacts 26 at the master controller and contacts 56 at the secondary controller are simultaneously closed, a circuit may be traced (in a fashion similar to that described for operating relay 67) to energize magnet 66 to withdraw latch 66' to effect release of relay 67 to turn off the lights of circuit No. 1. Switch 30 may be restored to its normal position after this operation has been effected.

In a manner similar to that described above, the lights of circuit No. 2 may be selectively turned on and off by proper actuation of switch 31.

It will be seen that means are disclosed for the completely independent control of two street lighting circuits. That the control is independent may be observed from the fact that sequential closure of contacts at the master controller and at the secondary controllers for turning on and off the lights of circuit No. 1 occur at different times during the cycle from the corresponding closure of the contacts for control of the lights of circuit No. 2. One of the two lighting circuits so controlled may comprise those which remain on all night, such as those at street intersections as represented by circuit No. 1, and those which are on just for the evening hours and are discontinued around midnight, such as white-way lights, as represented by circuit No. 2.

It is recognized that the point of supply for some street light circuits may not be near a secondary traffic controller. In this case, a local circuit for actuation of a contactor such as 69' may be employed extending from the most convenient secondary controller to the power supply point. An alternative will be to provide a separate controller of the secondary type but with the traffic control elements omitted and employing this controller merely for street lighting control.

Inasmuch as the total period of a traffic cycle is relatively long (generally a minute or longer) and the operating time of a relay such as 67 or a trip magnet such as 66 is relatively short, the traffic cycle may be divided into many separate elements with any pair of such elements adapted to effect the turning on or off of a street lighting circuit corresponding thereto. For this purpose, additional pairs of contacts such as 26 and 27, with actuators, and with a switch similar to 30, may be provided for each such separately controlled lighting circuit. Corresponding pairs of contacts and actuators, and relays and latch magnets, may be provided at each secondary controller at which the additional circuits are controlled.

The cams such as 46' are indicated as being fixed on their respective discs. These cams may be adjustable and may comprise pins which may be inserted, as by threading, into the periphery of the discs at such positions as are desired. The discs also, as an alternative, may be adjusted as desired around shaft 40 by suitable means. It is common in the street traffic signal control art to employ keys which may be inserted in desired positions in a dial or dials to effect circuit closure at predetermined times during the rotation of such a dial or dials. Such arrangements may be employed to selectively control street lighting circuits, so that any secondary controller may be arranged to be responsive to selective impulses for street light control at any time during the traffic cycle that is desired. That is, the master controller may be arranged to selectively and independently control lighting circuits at, say, ten different times during the traffic cycle, and such secondary controllers as may be desired may be arranged to control one or more lighting circuits at any of these ten different times by adjusting their contact actuators.

It is preferable for the traffic signal system employed for street light control to be of the type in which secondary controllers are operated in strict synchronism with the master controller. Some systems in commercial use are not of this type and generally are arranged so that the secondary controller always rotates slightly faster than the master controller. At the resynchronizing point, each secondary controler dwells momentarily until the resynchronizing condition is received, whereupon it starts another cycle. With such a system, the contact actuating arrangements for street light control may be so shaped that the maximum normal deviation of the secondary controllers from true synchronism will not result in either failure or false operation. Practically, this generally will mean that the lighting control contacts at the secondary controllers will be closed longer and the spread throughout the period of such contact closures will be wider than required with a true synchronous system.

FIGURE 2

Figure 2 shows the application of street light control in conjunction with controllers of the type set out in my aforesaid Patent No. 2,451,457. This figure corresponds generally to Fig. 11 of that patent, except that more structure is shown for a better understanding of the invention, and some features are disclosed which are alternatives of those previously shown, or are supplemental thereto. The designation of corresponding elements is the same in the present Fig. 2 as employed in my aforesaid patent to facilitate reference thereto, and the same general terminology will be used in describing it. Fig. 2 shows street light control by means which are also used for selective traffic-signal reset.

The several secondary controllers of the system are connected in multiple to three trunk conductors CR (common return), SET (setting of the controllers) and RS (resynchronizing), and these conductors are connected to the master controller. Conductor CR may be omitted and the grounded neutral of the power distribution system employed as a common return.

Each secondary controller includes a dial 102 affixed to shaft 201, which may be referred to as the synchronous shaft (S). This shaft at each secondary controller rotates in synchronism with, and predetermined fixed phase relation to, the corresponding shaft of the other secondary controllers and also the master controller shaft 1401.

Each secondary controller also has mechanism and circuit elements generally designated as 1402 for effecting various of the operations of the secondary controller, including the operation of signal lamps 707 and 708. The representation 1402 includes the secondary controller driving motor and speed (total traffic period) control arrangements. Also included in this representation are

other of the various elements of my aforesaid prior patent, including the drum controller for actuating the signal lamps with its associated elements, the reset shaft with its associated elements, the clutch with its control arrangements for changing the controller offset, means for effecting group control whereby the signals may be controlled independently in either of three separate groups, and other elements the purposes of which, and the arrangements for accomplishing these purposes, will be understood by reference to my aforesaid patent. Some of the detail elements and mechanism have, however, been separately shown in Fig. 2 for a better understanding of the relation between street light and traffic signal control.

The group in which a particular secondary controller will function is predetermined by the position of lever 104, which is shown in position G2, indicating that the particular controller now being considered is functioning in group 2. Lever 104 may be manually positioned and locked for group 1 or group 3, if it is desired to change the functioning of this controller to those groups. This lever controls circuit elements of 1402 by means of a rod extending through shaft 201, which is hollow.

Each, or certain selected, secondary controllers may be specially reset by means of a key 109 located in either of three radial slots of dial 102. This key has an actuating shoulder 223 adapted to engage and close either one of contact pairs 224, 225 or 226 depending upon the longitudinal position of said key. It is shown in position to close contacts 225 once each traffic cycle, i. e., once each rotation of shaft 201 and dial 102, at a time during the rotation of the dial determined by the particular slot which it is in. This provides special resets as brought out in my aforesaid patent.

Four other pairs of contacts are provided for control of two separate street lighting circuits, and the upper contacts of these pairs are connected in multiple to conductor 1150 which is also connected to the upper contacts of pairs 224, 225 and 226. Contacts 1106 are employed in a circuit to turn on the lights 1110 of lighting circuit No. 2, while contacts 1105 are employed in a circuit to turn them off. Likewise, contacts 1116 are in a circuit to turn on lights 1120 of circuit No. 1, and contacts 1115 are in a circuit to turn them off. The interrelation of relay 1107 and its unlatching magnet 1108, and the local street lighting circuit, are similar to those shown for corresponding elements of Fig. 1. A separate contactor and separate power supply may be used as with Fig. 1 instead of the direct operation of the lights as shown by Fig. 2.

It is well known in this and related arts that relays may be mechanically latched in their operated position or they may be electrically locked up. The control of street lighting circuit No. 1 is shown, for illustration, as being effected through the agency of an electrical lock-up circuit. Relay 1127 in its operated position completes street lighting circuit No. 1. This relay has two windings, the upper of which is connected to contacts 1116 to operate the relay while the lower winding is connected to its lower front contact. If this relay is operated, a circuit may be traced from power terminal 703, which is assumed to be the ungrounded side of an A. C. power source, rectifier 1129, the lower winding of relay 1127, its lower front contact and armature, the back contact and armature of relay 1128 to grounded power terminal 704. It will be seen, therefore, that this relay will be locked in its operated position under control of relay 1128. Provision of the rectifier (which may be of the full wave type) prevents relay 1127 acting as a transformer but, by proper design of this relay, the rectifier may be omitted. Should relay 1128 be operated with relay 1127 in its operated position, the locking circuit for the latter relay will be opened and it will be released. Relay 1128, consequently, provides electrically the functional equivalent of a latching magnet such as 1108.

At the master controller are the various elements required for effecting the various operations at the secondary controllers, controlling the total period of the cycle, driving the master controller, synchronism control and other functions set out in my aforesaid patent, and these elements have been generally designated 1140. A shaft 1401 (driven by the master controller driving arrangements) rotates in synchronism with, and in predetermined phase relation to, the shafts 201 at the secondary controllers, and has affixed to it disc 612 to control special resets and disc 1101 for street light control. Other discs, or the like, are also mounted on this shaft but are included in representation 1140. In order to simplify the drawing, the master controller is shown 180° out of phase with the secondary controller but both controllers are shown in phase from a control actuating standpoint.

Three holes are provided in disc 612, and a contact actuator 629 may be manually positioned and locked in either of said holes. This actuator is adapted to open contacts 626 momentarily once each traffic cycle; that is, once each rotation of disc 612 at a time during the cycle predetermined by the position of actuator 629. These contacts are normally short circuited by manual switch 627, so the cyclical opening of contacts 626 is normally ineffective.

Operation of Fig. 2

If it is desired to effect a special reset as controlled by actuator 629 in position 1 (as shown), switch 627 is opened for at least the interval during which actuator 629 will open contacts 626. A normally completed circuit may be traced from power terminal 601, switch 603, contacts 626, switch 1111, a normally closed circuit (indicated by a dashed line) through 1140, conductor SET, winding of relay 706, common return conductor CR to the other power terminal 602, and this circuit is momentarily opened when contacts 626 open. This results in the momentary release of normally operated relay 706 at each secondary controller. A circuit may now be traced at the particular controller under consideration from power terminal 703, armature and front contacts of normally operated relay 705, the back contact of relay 706 (now released), switch 721, and conductor 1150 to the upper contact of pair 225. Due to the position of key 109 in slot No. 1 of dial 102, contacts 225 are closed coincident witih the release of relay 706, since actuator 629 at the master controller and key 109 at the secondary controller are in the same relative positions (No. 1). Consequently, the aforesaid circuit traced to contacts 225 is extended through representation 1402, including electro-responsive means, to the other local power terminal 704. This results in a special operation or reset of the secondary controller as predetermined by arrangements included in representation 1402. It is evident that had key 109 been in its inner po-

sition of slot No. 1, contacts 226 would have been closed upon release of relay 706, and a different special operation or reset of the secondary controller would have been effected. A third such selection controlled by key 109 in its outer position can similarly be effected. It is evident that no special reset operation will be effected at the secondary controllers which do not have a key 109 in slot No. 1 of its dial 102. It is also evident that operations controlled by actuator 629 in position No. 2 or No. 3 may be effected at secondary controllers with keys 109 in corresponding positions. These arrangements and operations are fully set out in my aforesaid patent.

Let it be assumed that it is desired to turn on the street lights 1120 of circuit No. 1. Actuator 1102 is moved to the position "on" for the No. 1 lighting circuit on dial 1130. It is shown in this position. Switch 1111 is then opened, so that when contacts 1103 are opened by actuator 1102, the circuit through trunk conductor SET is interrupted momentarily to release relay 706. This results, as has been described, in power from terminal 703 being extended via conductor 1150 to upper contacts of pair 1116. Key 1140 in street light position No. 1 of dial 102 has an actuating shoulder 1141 which closes contacts 1116 coincident with this release of relay 706, so the latter traced circuit is extended through contacts 1116, the upper winding of relay 1127 to the other power terminal 704, causing said relay to operate and lock up as has been described. This results in street lights 1120 of circuit No. 1 being turned on by an obvious circuit through the upper contacts of relay 1127.

When it is desired to turn off the lights of circuit No. 1, actuator 1102 is moved to position "off" for lighting circuit No. 1 on dial 1101. The subsequent opening of contacts 1103 with switch 1111 open will cause relay 706 to release at the moment contacts 1115 are closed by the shoulder 1141 of key 1140. It is to be noted that contacts 1115 are arranged to be closed and opened subsequent to contacts 1116 being closed and opened. That is, a single broad shoulder 1141 is effective to separately close contacts 1116 and 1115 in sequence and, therefore, performs the effective functions of two keys by virtue of the contact design. A circuit can now be traced through back contacts of momentarily released relay 706 (in a manner similar to that described), closed contacts 1115, the winding of locking relay 1123 to the other power terminal 704. This results in relay 1123 operating to effect release of relay 1127 to result in the turning off of the street lights of circuit No. 1.

In a generally similar manner the street lights 1140 of circuit No. 2 may be turned on and off. To turn them on, actuator 1102 is moved to the "on" position for circuit No. 2, and switch 1111 is opened so that the circuit through conductor SET is momentarily opened to momentarily release relay 706. The release of relay 706 is coincident with the closure of contacts 1106 by shoulder 1143 on key 1142 to operate relay 1107 to turn on the lights 1110 of circuit No. 2. The armature of relay 1107 is latched operated. When it is desired to turn off the latter lights, actuator 1102 is moved to "off" for the No. 2 circuit and switch 1111 is opened. The resulting concurrent release of relay 706 and closure of contacts 1105 extend a circuit through magnet 1108 to withdraw the latch to result in the release of the armature of relay 1107 and opening of the light circuit.

Separate dials 612 and 1101 to provide special reset and street light control, respectively, have been shown to simplify the explanation. It is apparent that a single dial may be employed to accomplish both functions. Such a dial may have an actuator 629 with associated contacts 626 and shunting switch 627. In addition to having three holes, or the like, for positioning actuator 629 on the dial, it will also carry the four holes, or the like, in proper relative positions (as shown on dial 1101) for effecting street light control. The three special reset holes may be appropriately designated on the dial and the four street light holes may also be appropriately designated as to their on and off functions, and each pair as to the street light circuit which they control. It is further evident that these special resets and street light control may be provided with an actuator located on group reset dial 611 of my aforesaid patent so that all selective signal and street light control may be effected from the master controller by means of actuators on a single dial and a single set of normally closed contacts such as 626 with one shunting switch such as 627.

It is disclosed by Fig. 2, and in light of the teachings of my aforesaid patent, that the intersection controllers of a system may be operated in three basic groups as predetermined by the position of lever 104 at each of the secondary controllers. The secondary controllers may be regrouped for special resets in any of three special groups depending upon which of the three slots of dial 102 of the secondary controllers a key 109 is placed. Furthermore, the particular function of each secondary controller for any special reset may be predetermined by the distance key 109 is inserted so that it may actuate either its contacts 224, 225 or 226. It is moreover disclosed herein that two separate street light circuits at each secondary controller may be independently turned on or off as desired, and such turning on or off may be effected without resetting or otherwise affecting the operation of the traffic signal system.

It is to be recognized that these arrangements are not limited to turning on and off two street lighting circuits since it will be understood that by provision of additional lighting circuit arrangements with additional contacts actuated by additional street light control keys such as 1140, the number of circuits so controlled may be increased. It is further recognized that such arrangements may be employed for other purposes, such as air raid or fire warning signals, by substituting the appropriate element for such purpose for the street lights in a lighting circuit such as shown by Fig. 1 or Fig. 2.

FIGURE 3

The general arrangement shown by Fig. 2 may be improved effectively to eliminate accidental operation of street light circuits or signal operation resets by providing arrangements requiring a plurality of properly spaced circuit conditions to be transmitted from a master controller, and such an arrangement is shown by Fig. 3. Some alternative arrangements of those previously described and additional features are disclosed by Fig. 2, including visual indication at the master controller of the status of the street light circuits and the resets in which the system is operating. Only those elements necessary for the understanding of the present arrangement are shown by Fig. 3. The controller driving arrangements, signal light circuit control and other arrange-

ments have been omitted, but will be understood as being provided.

At the master controller is provided a bank of contacts and wiper 1401, said wiper being double-ended as is common with such arrangements. It is driven by the master controller arrangements at one-half revolution per traffic cycle or cycle of the secondary controller in view of the double-ended wiper. Connected to this wiper through the lower arm of switch 1408 is a relay 1402 adapted to transmit an impulse to the secondary controllers each time it operates to operate a relay 1403 at each of the latter, the circuit therefor being traceable from power terminal 1404, the armature and front contact of relay 1402, conductor SET, the winding of relay 1403, common return conductor CR (which may be the neutral of the power system) to the other power terminal 1405.

To illustrate the fundamental operation of the arrangement are shown conductors extended from bank contacts Nos. 2 and 4 to contacts of switch 1406, which has two positions to which it may be manually adjusted and in which it will remain. Switch 1406 is illustrating the control of street light circuit No. 1. A pair of indicating lights 1407 are arranged to indicate the status of circuit No. 1, which is assumed to be open, so the "off" light is burning by a circuit which can be traced from power terminal 1404, the left hand member of switch 1406, the "off" lamp of 1407 to the other power terminal 1405. A switch similar to 1406 with its associated lamps will be provided for each street light circuit which is controlled, with the right hand member of said switch arranged selectively to complete circuits to either of a predetermined pair of bank contacts. With switch 1406 in the position shown, the wiper of bank 1401 will be momentarily connected to power terminal 1405 once each cycle as it encounters bank terminal No. 2.

A switch 1408, which is common to the master controller, is provided to condition the secondary controllers for a street light circuit change or a traffic signal reset. When this switch is operated, it connects power terminal 1405 with bank terminal No. 1, so that this power connection will be encountered by the wiper once each cycle, it being recalled that a cycle with reference to the wiper is one-half cycle of the system. The resynchronizing moment during the traffic cycle is when the wiper is on bank terminal No. 24.

At the secondary controller is a circuit conditioning relay 1409 which latches operated under control of magnet 1410. Four circuit actuators or contact closers are shown schematically as are mounted on a shaft which constantly rotates discs or dials 1411, 1412, 1413 and 1414, and these in synchronism with, and in predetermined phase relation to, a corresponding shaft in each of the other secondary controllers and the wiper of bank 1401, it being recognized that 180° of rotation of the wiper is equivalent to 360° of the secondary controller contact actuators. Means not shown drives the shaft on which these actuators are mounted and maintains it in proper phase relation, as is disclosed in the street traffic control art. Each actuator closes its associated contacts momentarily once each cycle at a predetermined time as effected by the position of a cam such as 1411' on actuator 1411. More than four actuators with associated contacts may be provided.

Actuator dial 1411 with its cam 1411' and contacts are provided primarily to maintain the secondary controller in proper synchronous relation with respect to the master controller, and the upper set of contacts of dial 1411 are merely shown to indicate this function, and the familiar means for accomplishing it are omitted since they are well understood and are disclosed by patents which will be subsequently cited. The resynchronizing point in the cycle is when the master controller wiper is on bank terminal No. 24 as has been mentioned, and the designation 24 on actuator 1411 so indicates.

Dial 1412 with its cam and contacts is employed for conditioning the secondary controller for a street light operation or a signal reset. If relay 1403 is operated at the moment the contacts of dial 1412 are closed, a circuit may be traced from local power terminal 1415, the armature and contacts of relay 1403, the now closed contacts of 1412, the winding of relay 1409 to the other power terminal 1416, thereby operating relay 1409, which latches operated under control of release magnet 1410. With relay 1409 latched operated, subsequent operations of relay 1403 will cause a circuit to be extended from power terminal 1415, the armature and contacts of relay 1403, the lower armature and front contact of relay 1409 to conductor 1150 (which corresponds to conductor 1150 of Fig. 2) and thence to one contact of each pair actuated by dials or the like 1413 and 1414, and such other similar contacts which may be provided. Contacts associated with dial 1413 are closed in position No. 2 as indicated by the designation beside the cam of this dial for street lights off, and this occurs coincident with the wiper of the master controller being on bank terminal No. 2. Likewise, the contacts of dial 1414 are closed coincident with the wiper being on bank terminal No. 4 for street lights on.

Operation of Fig. 3

Let it be assumed that the street lights of circuit No. 1 are to be turned on. Switch 1408 is closed and switch 1406 is moved to its right hand position. When the wiper reaches bank terminal No. 1, relay 1402 and, consequently, relay 1403 will be operated while the contacts of dial 1412 are closed. It will be recalled that this will result in relay 1409 operating and being latched up. When the wiper reaches bank terminal No. 4, relay 1402 and then relay 1403 will be operated, and this will occur coincident with closure of the contacts of dial 1414. The previously traced circuit to conductor 1150 will be extended through the contacts of 1414 to the control circuit designated 1417 to result in the lights 1418 of circuit No. 1 being turned on by means described in connection with the prior figures of the drawings.

As the wiper traverses successive bank terminals, relays 1402 and 1403 will operate for each terminal connected to power terminal 1405 through a switch such as 1406. It will be recalled from what has been set out with respect to prior figures of the drawing, the condition of each of the street lighting and reset circuits will be checked. Let it be assumed that after the wiper has passed bank terminal No. 4 and street lighting circuit No. 1 has been turned on, switch 1408 is restored to its normal open position. This will stop transmittal of the control impulses to the secondary controllers. When each controller reaches its resynchronizing point (No. 24), the lower contacts of dial 1411 will then be closed (as shown). A circuit may now be traced from local power terminal 1415, the lower contacts of

1411, the upper armature and contact of relay 1409, the winding of latch magnet 1410 to the other power terminal 1416, causing the latch to be withdrawn and relay 1409 to be released, which in turn opens the circuit to magnet 1410. It will be seen that the secondary controller conditioning relay 1409 is released each time the secondary controller reaches the resynchronizing point.

The above arrangement requires that the secondary controllers be conditioned for a street light control operation or a reset at the beginning of a cycle and that the actual operation is separately effected subsequently during the same cycle. The conditioning function occurs immediately after resynchronizing occurs, which is the time during the cycle when all secondary controllers may be expected to be in synchronism. It also will be noted that conditioning relay 1409 is released at the end of each cycle, so that upon opening of switch 1408, the secondary controllers will be disabled for street light or reset operation after the resynchronizing point is reached. Subsequent operations of relay 1403 from any cause, such as reclosure of switch 1408, during the next cycle will not affect the secodary controllers.

The disclosed arrangements provide for a second protection against inadvertent street light or reset operation. This may be provided by employing position No. 1 for conditioning the secondary controllers and effecting the control operations in only the even numbered positions (bank terminals); the odd numbered terminals will not be used. This provides protection against a secondary controller falling out of step during a cycle when street light or reset operation is being effected. Under this condition, the contacts of 1412 might be closed while relay 1403 is operated for one of the street light or reset operations to operate the conditioning relay 1409. With the secondary controller now rotating in synchronism, but improper phase relation, relay 1403 will operate at various times as long as switch 1408 is closed. But the impulse which falsely operated relay 1403, and therefore relay 1409, came from an even numbered bank terminal (instead of odd numbered contact No. 1, as would be proper) and no contacts such as those of dials 1413 and 1414 will now be closed for even numbered impulses. This arises from the fact that the secondary controller under this condition is rotating sufficiently out of phase for the contacts of 1412 to have closed for the even numbered impulse which operated relay 1409, and this results in the contacts of dials such as 1413 and 1414 being closed for odd numbered impulses from the master controller. But the master controller only transmits even numbered operating impulses, so a false operation will not occur. As soon as the secondary controller reaches the resynchronizing point, conditioning relay 1409 will be released, as described, and the secondary controller may be expected to function normally.

In order to provide even further assurance against false operation, I may provide a separate dial with actuators adapted to complete a circuit from conductor 1150 of the secondary controller to operate release magnet 1410 for every odd numbered position (except No. 1) thereof. As a result of this arrangement, receipt by a secondary controller of an impulse while it is in an odd numbered position (other than No. 1) will result in release of conditioning relay 1409. It will be recalled that a secondary controller in proper operation should never receive an odd numbered impulse except in position No. 1, and the receipt of such an impulse results in disabling (by release of relay 1409) the secondary controller for light or reset control. Even should conductor SET be crossed with power or relay 1403 be stuck operated, the light and reset controls will be disabled as soon as the first odd numbered position (No. 3) is reached by the secondary controller after relay 1409 is operated in position No. 1. For still further protection, the first effective control position to be used may be No. 4 (instead of No. 2, as shown), in order to give the secondary controllers opportunity to release relay 1409 in position No. 3 if the circuit through the contacts of relay 1403 is closed in that position.

The selecting and effecting of various group or special resets are illustrated by Fig. 3, in which switch 1420 controls reset No. X. There may be one such switch for each reset to be selected at the secondary controller, or any of them. A signal lamp 1421 indicates, when lighted, that reset No. X has been selected. The operation of this arrangement is quite similar to that previously described with respect to Fig. 3 for street light control. When it is desired to effect reset No. X, switches 1408 and 1420 are closed. When the wiper of bank 1401 encounters terminal No. 1, each secondary controller conditioning relay 1409 is operated. When the wiper encounters bank terminal No. 22, relay 1402 is operated by a circuit from power terminal 1405, the left hand member of switch 1420, bank terminal No. 22, the wiper, the lower member of switch 1408, the winding of relay 1402 to the other power terminal 1404. The operation of relay 1402 results in the operation of relay 1403, as previously described, which connects power to the selective control conductor 1150. Contacts (not shown) at the secondary controller are closed in position No. 22 to extend the circuit from conductor 1150 to effect reset No. X as set out in connection with Fig. 2 and as shown in detail in my aforesaid prior patent. Indicating lamp 1421 will be lighted over an obvious circuit. After a complete cycle, switch 1408 may be released and conditioning relay 1409 at each secondary controller will be released when the resynchronizing point is reached.

While a separate switch 1420 is indicated for each reset, it is apparent that any convenient circuit controlling arrangement for the indicated objective of selecting a reset and connecting power terminal 1405 to the corresponding bank terminal and also lighting an indicating lamp (if such indication is desired) may be employed. This may include a manually rotatable dial type selecting switch or relay means with suitable operating circuits therefor.

It may be noted from Fig. 2 and in detail from my aforesaid prior patent, that keys 109 are provided so that any secondary controller may be specially reset in any of a plurality of predetermined manners without affecting other secondary controllers in their functioning in their respective control groups. This is accomplished from the master controller by transmitting a signal to the secondary controller at a time when either contacts 224, 225 or 226 of Fig. 2 are closed, dependent upon the desired reset operation. It is further indicated, in accordance with my aforesaid prior patent, that if a regular group reset signal is transmitted while a controller in that group is functioning for a special reset, the latter controller will be reset to the operation of

its group. That is, when any special reset is effective, it is desirable not to transmit normal group reset signals to the secondary controllers. In order to prevent such signals and assuming that switch **1420** is for a special reset selection, the latter switch (and other special reset switches) may be provided with another contact member to operate a relay which will disconnect from the bank terminals the conductors for the group resets. This will prevent the transmission of impulses for the regular group resets as the wipers are rotating while either a special reset is being selected or a street lighting circuit is being controlled.

While a single bank with a double wiper is shown by Fig. 3, and one cycle of the secondary controllers corresponds to one-half revolution of the wiper, it will be understood that two banks with single wipers on the same shaft may be used as is common with automatic telephony and other arts. With such an arrangement, the two wipers are 180° apart and only one wiper engages its bank contacts at a time. This doubles the number of separate bank terminals of a given size which are available for selective purposes, and enables the master controller wiper shaft to rotate at the same speed as the secondary controller selecting (synchronous) shaft. It is to be understood that the disclosure of a bank and wiper, or double bank and wipers, is illustrative of any suitable means for sequentially effecting circuit operations at predetermined times during a cycle. A drum controller for this purpose is an obvious alternative.

It is recognized that the master controller lamp signal indications as shown by Fig. 3 arise from operations to effect the remote functions in contradistinction to the result of such operations. It is to be understood in practicing this invention, a replica, or replicas, of a secondary controller may be provided at the master controller and connected to the trunk conductors, and this replica provided with indicating lamps to show what street lighting circuit is on and the reset which is in effect. Such an arrangement will provide indications to disclose the result of the selective operations.

FIGURE 4

Some traffic signal control systems in commercial use provide for the offset of the individual secondary controllers to be adjusted from the master controller. This enables a plurality of traffic flow plans (say three, for illustration, to be provided to facilitate the handling of the varying amounts of traffic in different directions which may occur at various times during the day. One familiar arrangement to effect this is to provide facilities whereby the secondary controllers may be resynchronized at any one of three (for example) predetermined times or points during the basic traffic cycle as indicated by the master controller cycle. This results in each of the various secondary controllers operating in any one of three predetermined phase relations, or offsets, with respect to the master controller. It is a further feature of such systems that the three phase relations or offsets in which a secondary controller may operate with respect to the master controller may be adjustably predetermined for each individual secondary controller. The patent to Vincent W. Leonard No. 2,328,473, August 31, 1943, is illustrative of such a system.

It will be recalled that a fundamental requirement of the present invention is to have an element at the master and each secondary controller which operate in predetermined phase relation as well as synchronism with each other so that light control contacts at both the master and all secondary controllers employed for street light control shall be concurrently operated momentarily during each traffic cycle. But with three different adjustable offsets of controllers of the general type of that disclosed in the Leonard patent, supra, such necessary predetermined phase relation is normally not provided, so special means may be employed with such a system to adapt it to street light control in accordance with the present invention. One such means is disclosed by Fig. 4. The basic principle involved in the disclosure of this figure is to effect street light control while all secondary controllers are operating in the same reset, and to arrange the secondary street light control contacts so that they will be operated in proper phase relationship with respect to the corresponding contacts of the master controller irrespective of the offset of the secondary controller for that reset.

Each secondary controller is provided with a driving motor included in representation **1501** to drive controller shaft **1502** one revolution each traffic cycle. The speed of shaft **1502** may be varied under control of the master controller by known means including circuit conditions over one or more trunk conductors represented by designation PC. Affixed to this shaft is dial **1511** having two rows of radial slots **1512** and **1513** (indicated by dashed lines) with, say, 100 slots per row. This dial may be similar to that of the aforesaid Leonard patent, and will carry six keys (not shown) in the outer row of slots **1512**, five of these keys actuating momentarily contacts **1517** at times during the cycle predetermined by the slots in which said keys are located, and contacts **1518** are operated momentarily once each cycle. Connected to these contacts is a six-position drum controller with its contacts and stepping magnet generally designated **1519** arranged to actuate signal lamps **1560** in accordance with the desired type of traffic cycle for which the drum controller is arranged. Since such arrangements are generally known and shown in the aforesaid Leonard patent, the detail description of them and their functions is unnecessary. Contacts **1518** maintain the drum controller in proper operating relation with dial **1511**. Contacts **1517** and **1518** are shown out of their proper relation for operation by the keys in the outer row of slots in order to simplify the drawing, but such relation and the mechanical design will be understood by the skilled in this art.

In the arrangement used for illustration, the shaft **1502** is driven by the motor of **1501** through a normally closed electromagnetic clutch **1503**, which may be of conventional design. This clutch is opened upon energization of its winding to result in stopping the rotation of shaft **1502**. Known means may be provided to hold shaft **1502** when it is disconnected from the motor by the clutch. Three pairs of normally opened contacts **1504**, **1505** and **1506** are provided for offset selection, with one contact of each pair connected in multiple to the winding of clutch **1503**. The other side of the clutch winding is connected to grounded power terminal **1507** at the secondary controller. To simplify this disclosure, it is assumed that the grounded

side of the power system is used as a common return for the control system.

The upper contacts of each contact pair 1504, 1505 and 1506 are connected to trunk conductors RS1, RS2 and RS3, respectively, which correspond to resets (offsets) No. 1, No. 2 and No. 3. In the inner row of slots of dial 1511, three keys 1514, 1515 and 1516 may be inserted. That is, any key may be inserted in any slot. Each of these keys has an actuating shoulder for one pair of reset contacts. Key 1514 has shouder 1514' to actuate contacts 1504 at a time during the cycle depending upon the slot in dial 1511 in which it is located. Likewise, shoulder 1515' of key 1515 will close contacts 1505, and shoulder 1516' of key 1516 will actuate contacts 1506. It will be seen that the contact pairs 1504, 1505 and 1506 may be closed individually at any time during the cycle as determined by the location of their corresponding keys in the dial, and these keys at each secondary controller may be located in different slots as required for the controllers to function to provide the three traffic flow plans desired since, as will be described, these three keys determine the three resynchronizing points of each secondary controller and, therefore, the offset of each such controller.

At the master controller is dial 1521 with contact actuator 1522 adapted momentarily to open normally closed resynchronizing contact pair 1523 once each traffice cycle. As with Fig. 2, the master and secondary controllers are drawn 180° mechanically out of phase but are in phase electrically. One contact of this pair is connected to power terminal 1509 and the other contact is connected to the arm of manually adjustable switch 1524, which may be positioned on either of three contacts or terminals connected respectively to the three reset trunk conductors RS1, RS2 and RS3. The switch is shown connected to the contact for conductor RS3. It will be seen that power is normally connected to the secondary controllers over the latter conductor and once each cycle this circuit is momentarily interrupted by the opening of contacts 1523 by actuator 1522.

It will be assumed that the secondary controllers are operating in the third reset as controlled by the circuit condition over conductor RS3. At the resynchronizing point for this reset (as determined by the position of key 1516 in dial 1511), contacts 1506 are closed. If the secondary controller is in proper phase relation with respect to the master controller for this offset, at the instant of closure of contacts 1506 there will be concurrent opening of contacts 1523, so the clutch 1503 will remain deenergized and the secondary controller will continue to be driven. Should the secondary controller get out of proper phase relation with the master controller, contacts 1506 will be closed without the concurrent opening of contacts 1523, and under this condition a circuit may be traced from power terminal 1509, contacts 1523, switch 1524, conductor RS3, now closed contacts 1506, the winding of clutch 1503 to the grounded power terminal 1507, which will result in the clutch being energized to stop the secondary controller with contacts 1506 closed. The secondary controller will remain stopped until contacts 1523 are opened, whereupon the clutch will be deenergized and the secondary controller will again be driven in proper phase relation with the master controller.

If it is desired to change the operation of the system to reset No. 1, switch 1524 is moved to its terminal connected to conductor RS1. Upon the next closure of contacts 1504 by the shoulder 1514' on key 1514, the clutch magnet will be energized to stop the dial with contacts 1504 closed and they remain closed and the magnet energized until contacts 1523 are opened, whereupon the secondary controller will again be driven in the phase relation determined by the location of key 1514 in the dial. It will be understood that each secondary controller of the system will similarly be reset, the time of stopping and the duration thereof of each controller being determined by the location of its key 1514 in its dial.

In a manner similar to that described above, reset No. 2 may be selected by moving switch 1524 to its middle contact, and the offset of each secondary controller will be established as determined by the location of its key 1515 in its dial.

It is to be understood that the showing of a normally closed electromagnetic clutch is merely indicative of known means for effecting resynchronization between a secondary and a master controller and alternative means with contact arrangements or other facilities for such means, which may be different from contacts 1504, 1505 and 1506 and their actuators, may be employed. The alternative means may include arrangements for stalling the drive motor, stopping it by means of a bucking coil, disconnecting the drive motor from the power supply, or any other suitable arrangements known to this art for effecting resynchronization.

Each secondary controller arranged for street light control has two contact actuator dials 1531 and 1532 with actuating cams thereon adapted to close contacts 1541 and 1542 at predetermined different times during the rotation of said dials. These dials are affixed to hollow shaft 1533 which may be rotated on shaft 1502. Also affixed to shaft 1533 is dial 1534 containing a single slot in which the end of key 1516 is inserted so that dial 1534 and actuator dials 1531 and 1532 will rotate with shaft 1502 and dial 1511 in the phase relation thereto as determined by the location of key 1516 in dial 1511.

The street lights and the control circuit therefor may be similar to the disclosure of previous figures of the drawings, and these are indicated by representation 1543. Contact pair 1541 controls the turning off and pair 1542 the turning on of the street lights. A second light circuit may be separately controlled by two other contact pairs closed by actuator dials similar to 1531 and 1532 as will be undertsood from what has been previously set out, and the breaks in shaft 1502 and hollow shaft 1533 indicate that such additional dials, etc., are contemplated.

Street light control of Fig. 4

The fundamental arrangement for selectively turning on and off of the street lights is similar to that disclosed by Fig. 1, and need not be again described in detail. Contact pairs 1551 and 1552 at the master controller control the turning off and on of the street lights as selected by manual switch 1555, said contact pairs being closed once each cycle by relatively displaced actuating cams 1553 and 1554. If the system is operating in reset No. 3, the momentary closure of contacts 1551 at the master controller and contacts 1541 at each of the secondary controllers is concurrent, and likewise there is concurrent closure of master controller contacts 1552 and secondary controller contacts 1542.

The problem presented in a multiple reset system of the general class described in which there

are multiple resynchronizing points at the secondary controllers is to provide means whereby the lamp control contacts at the various secondary controllers are closed at the same time as corresponding master controller contacts. The disclosed solution to this problem is to effect street light control while the system is operating in a particular one of its three resets, of which No. 3 is shown for illustration. This is accomplished by having the drive of the street light contact actuators effected by means of extension of key 1516, which determines the resynchronizing point for reset No. 3. Key 1516 may be located in any desired slot of dial 1511 as determined by the desired offset of a secondary controller for this reset. If key 1516 is changed to another slot from that shown for a different offset, the dial 1534 with its associated street light control actuator dials may be rotated to the proper position so that the single slot in dial 1534 will be located opposite the end of key 1516 in its new location so that the latter key may then be pushed through said slot to cause dial 1534 and its connected assembly to be driven in the relation to dial 1511 as determined by the slot therein in which key 1516 is located. It is to be noted that with the secondary controller operating in reset No. 3, the closure of contacts 1506 will be concurrent with the opening of master controller contacts 1523, and cams 1553 and 1554 have fixed relationship with respect to actuator 1522 on dial 1521. It is to be further noted that irrespective of the slot in dial 1511 in which key 1516 is located, the street light contact actuating dials 1531 and 1532 will have a fixed relation with respect to the latter key. It will be seen, therefore, that in reset No. 3, there is concurrent closure of contact pairs 1541 and 1542 at the secondary controller and contact pairs 1551 and 1552, respectively, at the master controller. This situation prevails at all secondary controllers irrespective of the offset in which they operate for reset No. 3.

It is to be understood that hollow shaft 1533 (or its equivalent) may be manually shifted to its proper position for reset No. 3, and locked in such position by any suitable means. Any suitable arrangement for positioning dials 1531 and 1532 in proper relation with respect to the resynchronizing point for reset No. 3 may be employed within the scope of this invention.

Since it is necessary for the system to be operating in reset No. 3 for street light control to be effected, means are provided to assure that the system is functioning in this reset and to prevent effort to control street lights while other resets are effective. This is accomplished by having a switch arm 1525 on the same shaft with reset selector switch 1524. When switch arm 1524 is in the position shown to effect resynchronizing for reset No. 3, switch arm 1525 is in contact with terminal 1526 connected to power terminal 1509. Arm 1525 is connected to the lower contacts of street light control contact pairs 1551 and 1552. It will be seen that power is connected to the latter contacts for street light control only while the system is operating in reset No. 3. Movement of switch arm 1524 to one of its other contacts will result in the power supply to the street light control contacts being broken at contact 1526, and the street light control arrangements are disabled except for reset No. 3.

It is to be recognized that the fundamental arrangement shown by Fig. 4 of shifting contact actuators, such as dials 1531 and 1532, to bear a predetermined relation to the resynchronizing point for reset No. 3 irrespective of the offset of that reset, provides means for effecting special resets with controllers of this general type. The special resets may be selected by additional contact actuators on hollow shaft 1533, so these contact actuators will always bear predetermined relationship to the resynchronizing point of the secondary controller for reset No. 3 and will, therefore, bear predetermined relationship with respect to special reset contact actuators on the shaft of the master controller, so that special reset contact pairs at both the master and each secondary controller may be concurrently closed (or opened) as required for special reset operation in accordance with the principle set out in my aforesaid prior patent and indicated by Fig. 2, hereof.

GENERAL

While two relays or a relay and a latch magnet are shown to control the lighting circuit, these are representative of any suitable contact closing and opening means for this purpose. Ratchet operated devices employing a single magnet are well known and may be employed for this purpose, and my aforesaid Patent No. 2,451,457 shows a principle which is available. Drum controller (D) of the latter patent is maintained in proper operating relation with respect to dial 103 by having the operating circuit for stepping magnet 701 controlled through contacts 738 of the drum controller. Application of this principle to the present invention will require provision of a pair of street lighting contacts which are closed, in say, odd numbered positions of the drum and opened in the even numbered ones. Contacts corresponding to 738 will be transferred for each position of the drum. The upper one of the latter contacts will be connected to contacts 57 of the present Fig. 1, and the lower ones connected to contacts 56. An impulse received over conductor SL while contacts 57 are closed will operate and release the stepping magnet to advance the drum to close the street lighting circuit and also to transfer the magnet circuit to contacts 56. An impulse subsequently received while contacts 56 are closed will result in the drum being stepped to its next position to open the street lighting circuit and to transfer the stepping magnet circuit to contacts 57. In practicing this invention, this principle may be more simply applied than by using a 6-position drum controller, and a two-position arrangement may obviously be employed.

It has been mentioned above that the present invention is applicable to various known traffic signal control systems and it has been further stated that certain elements appearing in certain of the figures are well known and therefore have not been shown in detail. Certain of the systems contemplated in the above include that disclosed in the patent to Bissell No. 1,929,378, October 3, 1933, which shows a resynchronizing system for a plurality of secondary controllers and total period control by means of a bucking coil arrangement. A step-by-step system is disclosed by Leonard No. 2,044,617, June 16, 1936. The Reid Patent No. 2,236,299, March 25, 1941, shows a drum controller actuating arrangement employing adjustable keys in a dial and a bucking coil to stop the secondary controller at the resynchronizing point should it fall out of proper phase relation with the master controller. Campbell et al. No. 2,050,039 shows a system in which the total

period control is effected by gear change arrangements and resynchronizing effected by stalling the drive motor or other suitable means. The signal lamp control contacts, in accordance with the present invention, when applied to this type of controller may be actuated from shaft 11 thereof and street light control effected with a particular one of the offsets effective, substantially in accordance with Fig. 4 of the present invention, with suitable means to shift shaft 1533 with its contact actuators to conform with the position of the lever which designates the resynchronizing point of the secondary controller. My prior Patent 2,173,596, September 19, 1939, discloses a resetting arrangement employing a secondary controller shaft driven in synchronism with the master controller either by a stepping magnet or motor driven arrangement. My Patent No. 2,126,144, August 9, 1938, shows a code system employing relays or the like which are operated in, say, 30 different combinations per traffic cycle to designate corresponding elements of the cycle. Appropriate means at the master controller and separate chain circuits at the secondary controller may be provided to be completed for two of these codes to turn on and off a street lighting circuit provided an impulse is received by the secondary over a trunk conductor at the times these chain circuits are completed, in a manner similar to the completion of circuits to the light control relays or the like by rotary contact actuators in accordance with the present invention.

It will be understood that the present invention is applicable to the above mentioned systems and to others in which there are means adaptable to provide concurrent contact actuation at the master and at the secondary controllers at predetermined times during the traffic or other defined cycle of the system. It is to be further understood that various of the driving, resynchronizing, offset changing, contact actuating and other arrangements shown by the prior art systems may be employed within the scope of the present invention to accomplish their respective detail functions. It is to be still further understood that the particular arrangements provided and results effected thereby in particular embodiments of my invention can be applied, as appropriate, to other embodiments thereof and other variations of the disclosed arrangements are contemplated within the scope of the appended claims.

What is claimed is:

1. In a control system, a circuit controller, a motor to drive said controller in recurrent cycles, traffic control signalling devices connected to and operated by said controller, a circuit distributor driven cyclically by said motor to partially complete electrical control circuits at predetermined parts of each of said cycles, electro-responsive control means connected to certain of said circuits to variably control said controller to correspondingly control the operation of said signalling devices dependent upon the completion to said electro-responsive means of circuits through said distributor, electro-responsive street light control means connected to other of said control circuits and variably operated dependent upon the completion of latter said circuits thereto through said distributor, street lights connected to and controlled by latter said means, and means connected to said distributor to complete circuits through said distributor at any of said predetermined parts of a cycle.

2. In a control system, the combination of a master controller provided with a motor to drive said controller in recurrent cycles, a circuit controller provided with a motor to drive said circuit controller in recurrent cycles, circuit means interconnecting said master controller and said circuit controller, means including said circuit means to cause said circuit controller to operate in synchronism with and predetermined phase relation to said master controller, selective means at the master controller for transmission to said circuit controller of circuit conditions at any of a plurality of predetermined times during a cycle thereof, means in said circuit controller variably responsive to said circuit conditions dependent upon the particular times during the cycle in which said conditions are transmitted, traffic signalling devices connected to and operated by said circuit controller, an electrical circuit connected to and operated selectively by means including said circuit controller dependent upon the time during the cycle thereof that the aforesaid circuit condition is transmitted from the master controller.

3. In a traffic control system, in combination, a master controller, electrical energy transmitting means thereat, a remote station, circuits interconnecting said controller and said station, traffic signalling devices at said remote station, means at said remote station to operate said devices at predetermined times in repeated cycles, a cyclical circuit controller at said remote station, an electrical circuit, means at said remote station responsive to a variation of energy received over said interconnecting circuits from said master controller and adapted, when said energy variation occurs in a predetermined part of said cycle of said circuit controller, to cause said signalling devices to be operated in another predetermined manner and, when said energy variation occurs in another predetermined part of last said cycle, to cause said electrical circuit in be completed, and means at said master controller to control the transmission of energy over said circuit connections.

4. In a traffic control system, in combination, a master controller, electrical energy transmitting means thereat, a remote station, circuits interconnecting said master controller and said remote station, traffic signalling devices at said remote station, means at said remote station to operate said devices at predetermined times in repeated cycles, means at said remote station to control the operation of said devices, an electrical lamp connected to said remote station, means at said remote station to control a supply of energy to light said lamp, cyclical circuit controlling means at said remote station, means at said remote station responsive to a particular variation of energy received over said interconnecting circuits and functioning through said cyclical circuit controlling means to selectively control said means to control the operation of said devices and said means to control the supply of energy to said lamp and adapted, when said energy variation occurs at a predetermined part of the cycle of said circuit controlling means, to cause said signalling devices to be operated in another predetermined manner and, when said energy variation occurs at another predetermined part of last said cycle, to cause said lamp to be lighted and, when said energy variation occurs at a third predetermined part of last said cycle, to cause said lamp to be extinguished, and means

at said master controller to control the variation of energy transmitted to said remote station.

5. In a control system, a circuit controller, a motor to drive said controller in recurrent cycles, traffic control signalling devices connected to and operated by said controller, a circuit distributor driven cyclically by said motor to partially complete individual electrical control circuits at predetermined parts of each of said cycles, electro-responsive control means connected to certain of said circuits to variably control said controller to correspondingly control the operation of said signalling devices dependent upon the completion to said electro-responsive means of circuits through said distributor, electro-responsive street light control means connected to other of said control circuits and variably operated dependent upon the completion of circuits thereto through said distributor, street lights connected to and controlled by latter said means, a cyclically operated master controller, circuit means interconnecting said master controller and said circuit controller, means including said circuit means for causing said circuit controller to operate in synchronism with and predetermined phase relation to said master controller, and means operable at said master controller and functioning over said interconnecting circuit means to selectively complete said control circuits through said distributor.

6. A control system for municipal streets including a master controller provided with a motor to drive it in recurrent cycles, a secondary controller provided with a motor to drive it in recurrent cycles, circuit means interconnecting said controllers, means including said circuit means to operate said secondary controller in synchronism and predetermined phase relation with said master controller, traffic signalling devices connected to and operated cyclically by said secondary controller, an electrical circuit operatively connected to said secondary controller, electrical impulse responsive means in said secondary controller to selectively control the operation of said signalling devices and said electrical circuit, means in said secondary controller to operatively connect said impulse responsive means to said circuit means at predetermined parts of the cycle of said secondary controller, and means in said master controller to selectively transmit electrical impulses over said circuit means to said secondary controller at any of said predetermined parts of the cycle thereof.

7. A control system for municipal streets including a master controller provided with a motor to drive it in recurrent cycles, a secondary controller provided with a motor to drive it in recurrent cycles, circuit means interconnecting said controllers, means including said circuit means to operate said master controller and said secondary controller cyclically in synchronism and predetermined phase relation with each other, traffic signalling devices connected to and operated cyclically by said secondary controller, a first electro-responsive device at said secondary controller to control the operation of said traffic signalling devices, an electrical circuit to be controlled, a second electro-responsive device at said secondary controller to complete said electrical circuit upon operation of latter said device, means to lock latter said device operated under control of a third electro-responsive device, circuit closing means to operatively connect said electro-responsive devices to said circuit means at individual predetermined parts of the cycle of said controllers, and means at the master controller to selectively transmit over said circuit means electrical impulses at any one of said predetermined parts of the cycle of operation of said controllers.

8. A control system for municipal streets including a master controller driven cyclically by a motor, a secondary controller driven cyclically by a motor, circuit means interconnecting said controllers, means including said circuit means to operate said secondary controller in synchronism and predetermined phase relation with said master controller, traffic signalling devices connected to and operated cyclically by said secondary controller, an electrical circuit operatively connected to said secondary controller, electrical impulse responsive means in said secondary controller to selectively control the operation of said electrical circuit, means in said secondary controller to operatively connect said impulse responsive means to said circuit means at predetermined parts of the cycle of said secondary controller, and means in said master controller to selectively transmit electrical impulses over said circuit means to said secondary controller at any of said predetermined parts of the cycle thereof.

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