

July 5, 1938.

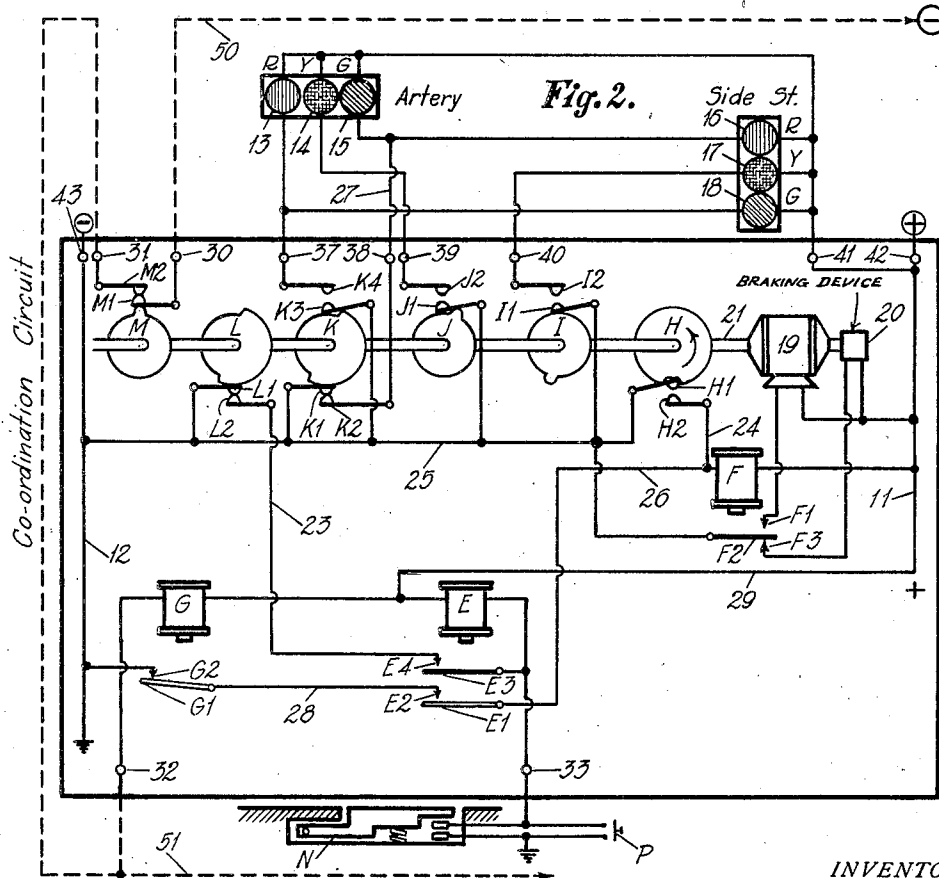
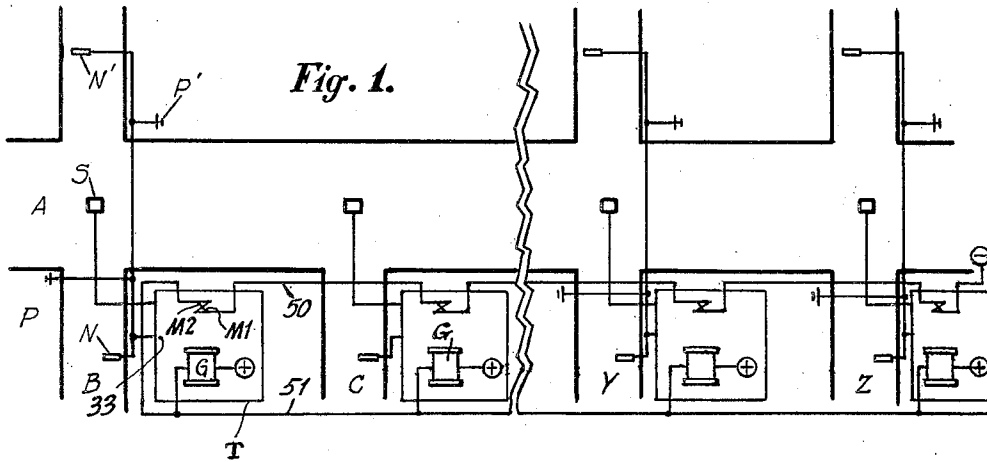
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2,122,410

TRAFFIC CONTROL SYSTEM AND APPARATUS

Filed Nov. 12, 1934

3 Sheets-Sheet 1



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TRAFFIC CONTROL SYSTEM AND APPARATUS

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3 Sheets-Sheet 2

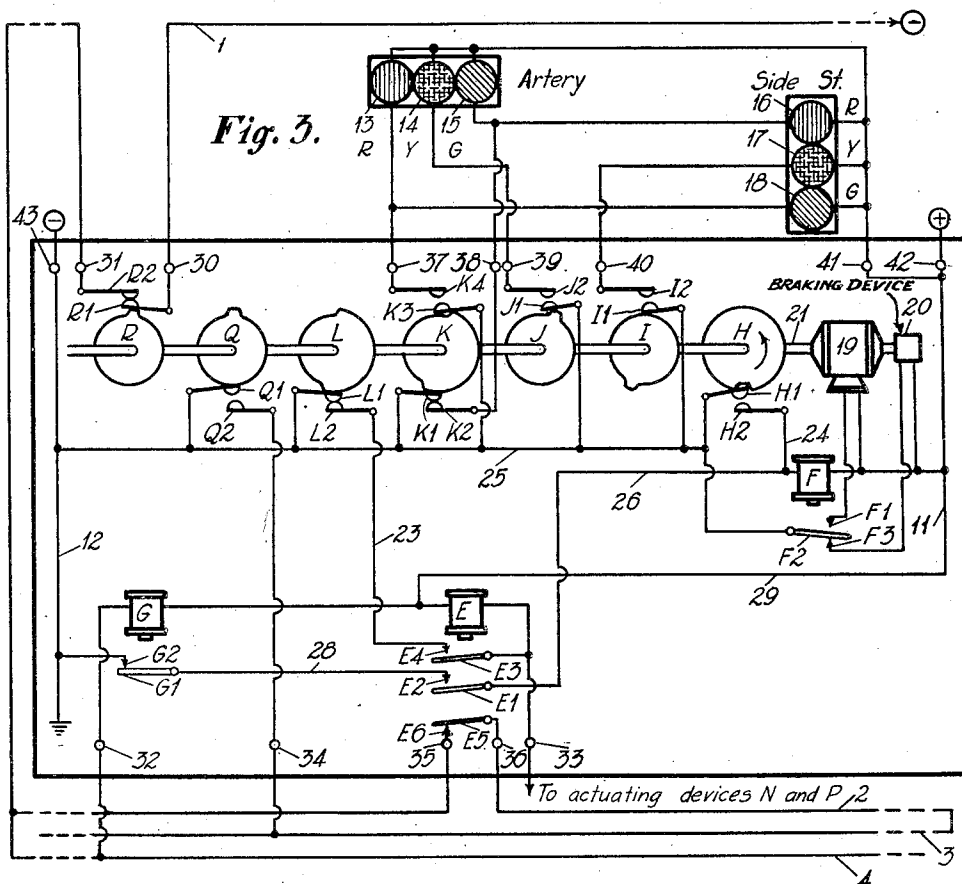
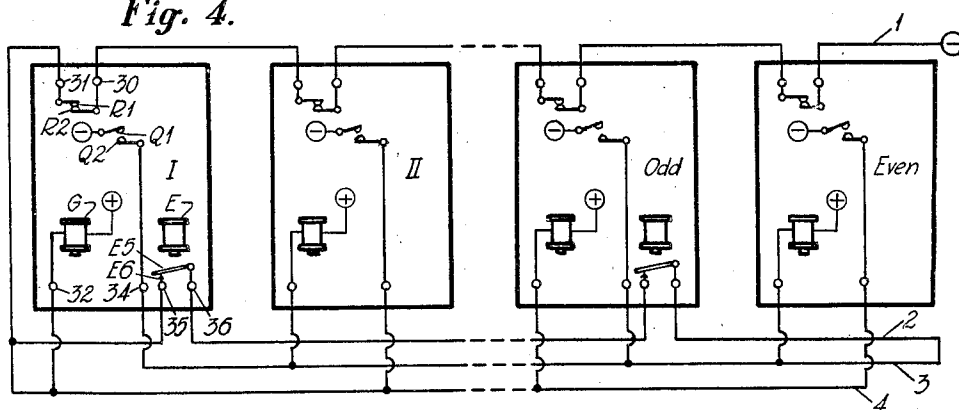


Fig. 4.



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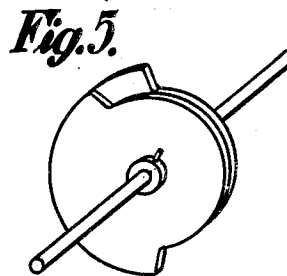
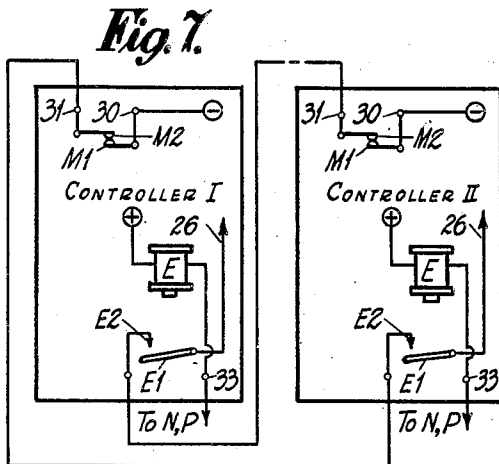
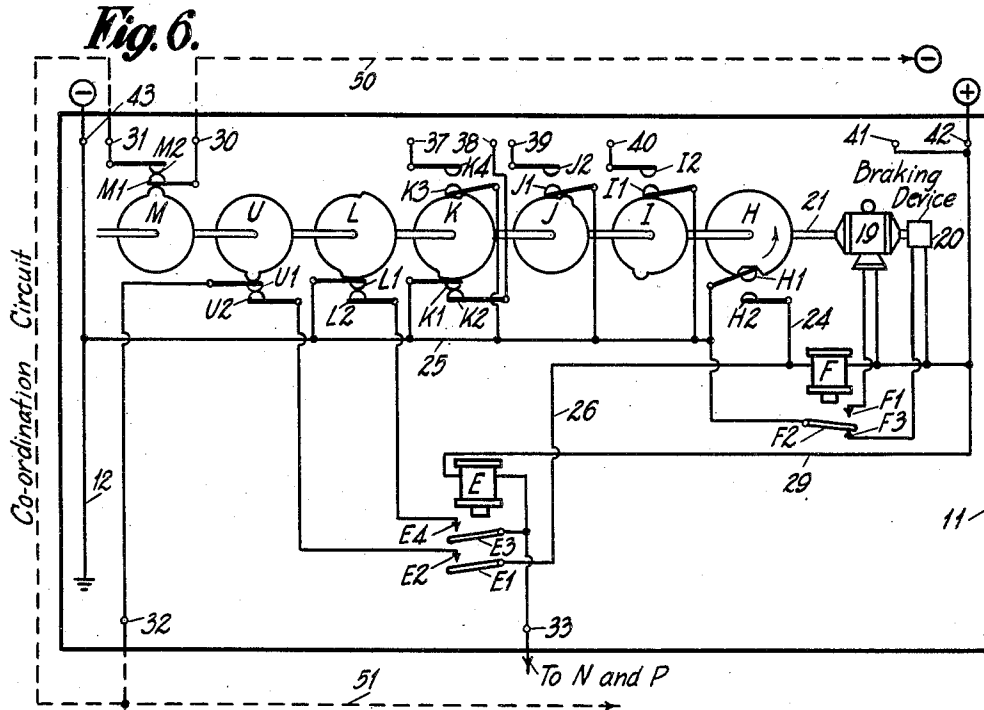
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TRAFFIC CONTROL SYSTEM AND APPARATUS

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3 Sheets-Sheet 3



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2,122,410

TRAFFIC CONTROL SYSTEM AND APPARATUS

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Application November 12, 1934, Serial No. 752,606

22 Claims. (Cl. 177—337)

This invention relates to traffic-controlling systems and has for its general object to provide a new and improved traffic-controlling system and apparatus therefor, capable of numerous different associations, but primarily designed for use at a plurality of intersections of one main traffic lane with several cross traffic lanes.

Traffic control systems have heretofore been proposed for use at an intersection of a highway with a side street or cross lane for transferring right of way to the side street at such times as vehicles may by appropriate means register their approach along the side street, each intersection having its own independent control mechanism.

Such systems, however, if installed at a series of closely spaced intersections frequently cause considerable successive stopping and undue delay of traffic on the main highway, especially in periods of heavy traffic, insomuch as no provision is made for the co-ordination of the phase relations of signal periods at successive intersections.

Other systems have heretofore been proposed for operating the signals at a succession of intersections on a vehicle lane in predetermined cycles, such that right of way will be accorded to the main vehicle lane at all intersections for a period, and upon its expiration right of way will be changed to all the cross lanes, so that cross traffic can proceed.

Such schemes, however, using the predetermined synchronized cycle and the periodic timing commonly known as fixed time control, impose delay to the main street traffic unnecessarily when there are no vehicles crossing the intersections on the side streets, and similarly unnecessary delay may be placed on side street traffic in periods of light traffic, if there are no vehicles on the main street.

Still another proposed system co-ordinates a series of intersections in such manner that instead of right of way being accorded to traffic on all cross streets simultaneously, right of way is extended to cross streets according to a pre-established progressive scheme, so that vehicles on the main street travelling at a certain speed may pass through the entire group of intersections without stopping.

Such progressive systems likewise may impose unnecessary delay on the side street traffic, and although it overcomes to a considerable extent multiple stopping on the artery, the difficulty of adapting it to irregularly spaced intersections makes desirable in many instances the avoid-

ance of stopping when no cross traffic is present.

The principal object of this invention is the provision of a novel system and apparatus whereby the defects and disadvantages above outlined are overcome and whereby: 1, in conditions of light traffic the co-ordinating effect is minimized and freer movement of side street traffic is insured; 2, under medium traffic conditions response to side street vehicle actuation continues as a dominant factor, but not to such an extent that frequent multiple stopping will be required of any vehicle on the artery; and 3, in heavy traffic, by controlling the ability of the individual signal controllers to respond to vehicle actuation in accordance with some co-ordinated plan, the passage of artery traffic will be expedited with as few stops as possible, thus preventing repeated or multiple stopping of much traffic and the resulting highway congestion.

Another object is to provide a system of this character which will allow the individual controllers to respond independently to actuations of approaching cross traffic after a period of absence of cross traffic at all intersections of the group.

A further object is to provide apparatus of this character in which a system of co-ordination of the traffic controllers is initiated when right of way is removed from the through or main traffic lane at any of the different intersections.

Still another object is to provide traffic control systems and apparatus such that when the presence of traffic makes co-ordination desirable, the controllers at the several intersections of the group exert mutual control over one another.

It is a further object of the invention to provide a traffic control system which in periods of heavy traffic will allow traffic on the through lane to move along said lane with a minimum of multiple stopping, yet for part of the time right of way will be accorded to those side streets on which traffic approaches.

A still further object is to furnish apparatus of this character which, because of the mutual co-ordinating of the controllers by one another, requires no central or other supervisory co-ordinating control apparatus, yet at the same time requires few interconnections between the unit controllers.

Another object is to provide apparatus employing a minimum number of individually simple and ruggedly constructed parts such that the units upon assembling will comprise a system that will be free from electrical and mechanical difficulties over long periods of time.

Still another object is to provide apparatus of a type that will readily be adaptable to co-ordinate many different types of traffic-actuated traffic control devices.

5 Other objects will subsequently appear.

The problem of obtaining such a combination of desirable features is made easier by subdividing the types of series of intersections where these installations are to be made.

10 At a group of intersections spaced close together, where a vehicle stopped at the first can pass through all the intersections in the right of way period of a single cycle of ordinary length, a system of synchronized co-ordination, hereinafter designated as plan A, is proposed.

15 At a group of several intersections spaced somewhat farther apart than in the above group, yet still close enough together to be benefited by co-ordinated control, a system of progressive co-ordination, hereinafter designated as plan B is proposed, in which the signal periods of controllers at adjacent signalized cross streets have a definite phase relation, of, for example, 180 degrees.

25 The invention will be described and explained in detail in connection with the accompanying drawings, illustrating practical embodiments of the invention, and in which:

30 Figure 1 represents diagrammatically a series of intersections, traffic passing through each being regulated by an apparatus embodying the principles of plan A of the invention, and employing suitable signal indicators, such as a system of colored lights or lenses, a number of devices which register the approach of vehicles or of pedestrians desiring to cross the artery, and the interconnections necessary for the co-ordination of the controllers at each intersection.

40 Figure 2 is a schematic representation of the control apparatus for each intersection and indicates one plan of connections utilizing the principles of plan A.

45 Figure 3, somewhat similar to Figure 2, represents a control apparatus for the intersection of a cross street with the main highway, of the type employed for control by plan B.

Figure 4 is a diagrammatic view of the several units and interconnections employed in an installation of the type of plan B.

50 Figure 5 shows a form of adjustable cam for use in the control apparatus.

55 Figure 6 represents a control apparatus similar to that shown in Figure 2, in which a pair of cam-operated contacts has been substituted for the relay G and its contacts.

60 Figure 7 is a diagrammatic representation of two control units of the type shown in Figure 2 interconnected, showing the simplification in the mechanism and wiring which may be effected when only two such intersection controls are co-ordinated.

65 Principal benefit is derived from the use of the apparatus of plan A when it is installed at the several intersections of a number of closely spaced side streets that are crossed by an arterial highway. Normally it permits vehicles approaching the group of intersections along the artery to proceed through the entire group. However, when the right of way has been accorded to the artery for at least a definite pre-established minimum period, a vehicle on any of the side streets, which by operating a detecting or vehicle responsive device has indicated its approach to pass through the intersection, 75 may cause the arterial traffic flow to be inter-

rupted in order that the vehicle on the side street may proceed. Similarly pedestrians at the intersection who, desiring to cross the thoroughfare, have pressed a button provided for this purpose, may also interrupt traffic flow on the artery. 5 When the artery traffic has thus been stopped, however, the apparatus will not again for a definite period permit another such interruption at any of the groups of intersections, but upon the expiration of said period, any side streets where vehicles have actuated the detectors will be allowed right of way. 10

15 It will be appreciated that the present invention might advantageously be employed in some situation other than the above, and therefore the drawings and specification herein are to be construed as illustrative only.

20 In Figure 1, A indicates a highway, and B, C, Y, Z, representative cross streets, intersecting or ending at the highway. T represents a controlling mechanism at street B; S, the signal at B; N and N', the vehicle actuated detectors in street B; P, a pedestrian push button at street B; and 50 and 51, a pair of wires connecting together the control units at the several intersections, for purpose of co-ordination of their operation. Controlling mechanisms, signals, vehicle detectors, and pedestrian push buttons, similar to those at B, are located at each of the other regulated intersections of the series and references hereinafter to street B or to any of the apparatus at B are to be considered as exemplary and typical of any of the other intersections. 30

35 The apparatus may employ any suitable signal but, as an example the signal in use with the present embodiment includes a housing in which colored lamps, lenses, and/or reflectors, may be used for displaying, for instance, green, red, and yellow, indicating respectively the right of way, interruption of right of way, and an impending change in right of way in the main and cross streets, in accordance with familiar practice. 40

45 In this illustration pressure operated switches in the pavement units are operated by the weight of vehicles traversing them, but any other form of device which will control an operating circuit upon the approach of a vehicle to the intersection may be employed.

50 In Figure 2, there is illustrated schematically the signal controlling mechanism or controller for one intersection with its connections to the signals and traffic detectors in accordance with plan A; and the wires 11 and 12 indicates power supply leads from any suitable source and to which, for example, the lamps 13-18 may be connected in a manner hereinafter described. These lamps are contained within the signal S, and similar sets are located within the similar signals at the other intersections controlled by the system. 60

65 A motor 19, which may be electrically driven, drives shaft 21, preferably through a reduction gear (not shown). A braking device 20, which may be a magnetically operated friction brake, may be employed to bring the motor quickly to a full stop and prevent revolution of the cam shaft 21 whenever the motor operating circuit is interrupted by relay F. On the shaft 21 are mounted a number of spaced, adjustable cams, H, I, J, K, L, M, each insulated from the camshaft. These 70 cams may be of the type shown in Figure 5, in which each cam consists of two disks mounted with their faces together and their hubs outside, so that the sector of the effective portion of cam having major radius can be altered as desired 75

by revolving one disc in respect to the other on the shaft. Each cam is held in its desired adjustment position and in its desired phase position on the shaft by set screws or other convenient means. Operating in conjunction with each of the cams are one or more circuit-making and breaking members, so arranged that whenever the portion of the cam having the larger radius is rotated into conjunction with the circuit-making member, the latter is pressed into engagement with its mate, enabling the circuit to be closed. Contacts K1 and K2 which can thus be closed by cam K are disposed in series with artery green and side street red illuminating units 15 and 16, between leads 12 and 11. Likewise, units 13 and 18, artery red and side street green, are in series with contacts K3 and K4, and yellow units 14 and 17 are energized through contacts J1 and J2 and contacts I1 and I2 respectively.

The vehicle-actuated detectors N and N' and the pedestrian push buttons P and P' are connected in parallel, and are interposed between a relay E and ground. Also arranged between relay E and grounded lead 12, paralleling the detector circuit, is a lead 23 in series with circuit breaker E3, E4, which is a part of relay E, and circuit breaker L1, L2 operated by cam L. A relay F is connected directly to lead 11, and to lead 12 by two parallel circuits, one through lead 24, circuit breaker H2, H1, actuated by cam H, and lead 25; the other by lead 26, circuit breaker E1, E2, associated with relay E, lead 23 and circuit breaker G1, G2, which is a part of a third relay, relay G, whose function will be described hereinafter.

When relay F is energized, its armature F2, engages with contact F1 and completes the circuit from leads 12, 25, to the motor 19, and when relay F is de-energized, the same armature F2 completes circuit through the braking mechanism 20 by engaging contact F3.

The position of the parts shown in Figure 2 is the normal resting position thereof in any one of the controllers of the group. Relay G is shown energized as it is assumed for illustration that all controllers are in their rest positions and the series circuit through all contacts M1-M2 is closed as shown in Fig. 1. The operation of one such controller, if allowed to function independently, follows.

Units 15 and 16 will be energized by a current flowing through lead 25, contacts K1 and K2 and lead 27. Consequently right of way will exist on the artery. The camshaft will be in its rest position and stationary. If now a vehicle approaches along the side street at its intersection with the thoroughfare where the present controller is located, the vehicle will operate detector N, thereby momentarily energizing relay E. Relay E will continue to receive power after the initial momentary energization, however, and remain "locked-in", by a circuit from lead 12, through lead 25, cam contacts L1, L2, lead 23, contact E4 and armature E3.

The relay E will also attract its armature E1, which, assuming for the present the energization of the co-ordinating relay G and closure of its contacts, will close a circuit from lead 12, contact G2, armature G1, through lead 23, contact E2, armature E1, lead 26 to motor-controlling relay F. This in turn pulls armature F2 away from contact F3, releases the brake mechanism 20, and by closing armature F2 against contact F1, energizes the motor 19 causing camshaft 21 to revolve slowly. As soon as camshaft 21 has rotated

off the rest position, a circuit to relay F paralleling the one through circuit breaker E1, E2, lead 26, just described, supplies power for the remainder of the cycle to relay F through lead 24, contacts H1, H2, and lead 25, after relay E has become de-energized. Once the camshaft 21 has again reached the rest position, relay F must be energized through lead 26 for restarting, since contacts H1, H2, are open at this time.

Upon starting of camshaft 21 from rest the movement of cams J and K will be such that by the closure of contacts J1, and J2, yellow will appear on the artery in addition to the green, and shortly thereafter these lights will be replaced by artery red 13 and side street green 18, since contacts K3 and K4 will have come into engagement. Accordingly right of way will be transferred to the side street, for a period of time determined by the shape and position of the cams and the speed of the camshaft.

At the termination of side street right of way interval, cam I causes yellow to appear on the side street by energizing unit 17 through contacts I1 and I2. Artery green, 15, and side street red, 16, are restored a few seconds thereafter by cam K which closes contacts K1 and K2. This condition of the signal S will be maintained throughout the remainder of the revolution of the camshaft to resting position, and thenceforth until an actuation shall have been received either by detector N or by push button P, whereupon the cycle already described is repeated.

Provision is made for "remembering" the approach along the side street of a vehicle which cannot immediately be granted right of way, by means of the lock-in circuit. Actuation of the detector N energizes relay E and causes armature E3 to close circuit with contact E4. Current then flows through leads 12, 25, circuit breaker L1, L2, lead 23, contact E4, armature E3, relay E, to lead 29 and lead 11, and this continues to energize relay E until camshaft 21 has rotated to the side street green position. At this time cam L allows separation of contacts L1, L2, breaking the circuit. Cam L may be adjusted to lock-in detector relay E during side street red and amber periods, and also during the last few seconds of side street green period so that a vehicle approaching the intersection and failing to cross before right of way is shifted, recalls right of way at the earliest opportunity possible.

Co-ordination of a series of controllers is accomplished according to plan A by the following additions to the above outlined equipment.

A cam M is mounted on the camshaft 21, and by means of circuit breaker M1, M2, is arranged to interrupt the outgoing co-ordination circuit 50, which interconnects in series the corresponding circuit breakers of all the controllers. This can be seen in outline in the lower part of Fig. 1. A terminal 30, at cam contact M1, in the controller at one end of the series is grounded, and terminal 31, joined to cam contact M2, in the controller at the other end is connected to the incoming co-ordination wire 51, which electrically connects corresponding terminals 32 of all controllers. Coordination relay G has one side connected to lead 11 by lead 29 and the other to incoming co-ordination wire 51 at terminal 32. Therefore only at such times as contacts M1 and M2 are closed by cam M and the corresponding contacts are closed at all of the other intersections in the series, will the co-ordinating relay G be energized.

The operation of this apparatus in controlling

the controllers in the group follows. Assume camshaft 21 of each controller to be in its resting position, and further assume that no traffic is approaching on any of the side streets. In each controller contacts M1 and M2 will engage, permitting co-ordinating current to flow in circuit 50—51 and energizing each relay G. If now a vehicle approaches along a side street, for example, street B, detector N will be operated and cause relay E (in the controller at B) to become locked-in in precisely the manner described in connection with independent operation. Since a circuit from lead 11 through relay F, lead 26, armature E1, contact E2, lead 28, armature G1, contact G2, to ground is now completed, the relay F is energized and the motor at B is started.

After camshaft 21 has revolved to the side street green position and this signal has been displayed for a few seconds, cam M causes contacts M1 and M2 of the controller at street B to separate, interrupting the flow of current in co-ordination circuit 50—51. The opening of this circuit, by de-energizing relay G in each controller, will open one of the two parallel circuits from ground to motor-controlling relay F; the circuit through leads 28 and 26 to relay F, between contact G2 and armature G1. Relay F remains energized in the actuated controller, i. e. that at B, through the parallel circuit from ground through lead 25 and circuit breaker H1, H2, until the camshaft 21 has rotated to its rest position, where cam H interrupts the circuit between H1, H2. Hence the power supply to motor 19 is intercepted by armature F2 of relay F. Under no conditions can the motor-driven camshaft 21 of any controller pass through or leave its rest position unless both relays G and E of the controller are energized, thus allowing relay F to receive power. Since relay G must be energized for motor 19 to operate in the rest position, a condition of rest with green on the artery must therefore obtain at least until each controller in the series has returned to the position allowing permissive co-ordinating current to flow to relay G of all controllers; i. e., the rest position. The controller camshaft will remain in the rest position both until co-ordination relay G has been energized and until an actuation of side street detector N locks-in relay E. Controllers at other intersections are permitted to leave the rest position in response to actuation at their respective intersections as long as cam M maintains contacts M1, M2, closed. As cam M can be adjustable, the permissive circuit to other controllers may be closed through the rest period, the artery yellow period, and also if desired during the first part of the side street green period.

From the above it will be seen that when existing traffic conditions have allowed the controllers at the several intersections all to be in their rest position, the co-ordinating effect is removed until actuation of a detector occurs on one of the side streets. The significant features in reducing delay to traffic in both the main and cross lanes are that no controller can transfer right of way from the highway to a side street except when traffic is present on the side street, that co-ordination of the controllers is not initiated until an actuation of a side street detector occurs, and that as long as co-ordination is desirable to prohibit excess multiple stopping of traffic on the highway, controllers at the several intersections have a mutual control over one another.

It will be observed that in each of the controllers other means may be substituted for relay

G. For instance, in Fig. 6, which represents a control apparatus similar to that shown in Fig. 2, a pair of contacts U1, U2 operated by a cam U mounted on shaft 21 may be arranged to close a circuit in the rest position between terminal 32 and contact E2 in lieu of the contacts of relay G and will accomplish the same function as the circuits including relay G and its contacts indicated in Figures 2 and 3.

When the present traffic control apparatus is installed to co-ordinate signals at only two intersections, simplifications in the controllers are possible. An installation of this type involving only two controllers, each being generally similar to the machine represented in Figure 2, is diagrammatically shown in Figure 7. It will be seen that the co-ordinating wires 50 and 51 of Fig. 2 may be replaced as shown in Fig. 7 by two wires, each of which leads from terminal 31 of one controller directly to contact point E2 of the other. Each terminal 30 must be connected to negative potential. Relay G can now be eliminated from both controllers. Thus the co-ordinating negative current will be furnished directly from one controller to the motor-controlling relay F of the other, through contact E2 and armature E1, so that the ability of each controller to respond to actuation is governed by the other controller in the case of only two intersections in a manner similar to that described above for more than two intersections.

In Figure 4 is disclosed a diagrammatic form of the arrangement for co-ordinated operation of a series of traffic controls of the traffic-actuated type, according to plane B. I, II, ..., represent the controls at the first few locations in a series along a highway, spaces between locations being approximately equal. At each of these points there may or may not be a side street intersecting the main highway. If there is no side street at one of these points, the portion of the equipment for such intersection may be omitted. Each intersection and the controller located at each intersection are classified as being in the "even group" or in the "odd group" accordingly as they are located at an even-numbered point in the series or at an odd-numbered point. In Figure 3 are presented the details of a wiring diagram for a traffic control device at one of the intersections in the odd group. Controllers in the even group are similar in all respects to those of the odd group, except as hereinafter disclosed.

That part of the controller which operates the signals for indicating right of way to vehicles approaching the intersection, that is, the signal lights 13—18, motor 19, brake 20, cam-shaft 21, motor relay F, detector N, detector relay E, relay G, and cams H, I, J, K, and L, can be of the type described in the preceding part of this specification. Likewise, operation of the controller when used as an independent controller, is similar to that disclosed above.

Cam R is arranged to close circuit in wire 1 by causing engagement of contacts R1 and R2. Cam Q provides a means of effecting closure of contacts Q1 and Q2, 180 degrees later in the cycle or one half revolution of the camshaft 21 after cam R has operated its contacts. Q1 is connected to negative lead 25 and Q2 to wire 3.

Referring again to the group diagram of Figure 4, it is observed that four wires interconnect the several controllers of the installation. Wire 1 (grounded at one end, and at the opposite end joined to wires 2 and 4) connects in series the contacts R1, R2 of each installation. Wire 2, 75

from its junction with 1, leads through each odd-group machine where it is in series with circuit breaker E5, E6, affiliated with relay E, and after passing through the last controller of the group is connected to wire 3. Wire 3 in turn interconnects the contact Q2 of each controller of the odd group and one side of relay G of each machine of the even group. Wire 4, in the same way, interconnects contacts Q2 of the even group controllers and one terminal of relay G of the controllers of the odd group.

Operation of the apparatus will be described, first assuming that the camshaft 21 of each controller is in its rest position, and that there is for the present no traffic actuation.

Current will be flowing through wire 1, through each pair of contacts R1, R2 and wire 4 to energize the relay G of each odd-group controller. Also current will flow through wire 1, wire 2, circuit breaker E5, E6, of each odd-group controller and thence through wire 3 to the relay G of each even-group controller. Therefore, each relay G will be energized and any controller may yield right of way upon actuation of the detector in that street.

Now assume that actuation is received by the detector in street B, a street in the odd group. Referring to Fig. 3, relay E of the controller at B will be operated by the actuation and become locked-in by a circuit through armature E3, contact E4, lead 23, and contacts L1, L2 of lock-in cam L, to ground. Energizing relay E opens co-ordination circuit in wires 2 and 3 and thus prevents any even-group controllers from according right of way to their side streets, since their G relays become de-energized when current in wire 3 is interrupted. Current will flow through circuit-breakers G1, G2, E1, E2, lead 26 to motor-relay F, which will be energized to close the motor operating circuit between armature F2 and contact F1, after opening the braking control circuit through contact F3. Camshaft 21 of the machine at B will commence to revolve, and as in the plan A controller right of way will be accorded to the side street. Cam R will then break circuit through wires 1 and 4, preventing all other controllers in the odd group from leaving their artery green resting position.

When actuation occurs first on a street in the even group, co-ordination current will be flowing in circuit in wires 1, 2, 3 and 4 to energize the relay G of all controllers until the even group controller revolves to the point where cam R opens contacts R1, R2, stopping all permissive current. In the event of simultaneous or near simultaneous actuation of detectors on streets in both groups, provision is made for the odd-group controller to be dominating so that both odd and even-group controllers cannot yield right of way at once. At the instant a controller in the odd-group receives an actuation, the energizing of its E relay interrupts permission to the even-group controllers, which stop if they have just been started and have not yet had time to leave the rest position. The rest period, although short, is appreciable and of sufficient length for an even-controller to be stopped by the starting of a dominant odd-controller immediately after the start of an even-controller. However, if an even-group controller is actuated sufficiently ahead of any odd-group controller so as to leave its rest position ahead of the odd-group controllers, the even-group controller will as it leaves the rest position, stop any odd controller which may have just been actuated. Obviously, if it

were desired to make the even-group controllers dominate instead of the odd-group controllers, the arrangement of the circuit 2 in Figure 4 would be transposed with respect to the relay E contacts of the odd and even controllers in this figure; that is, the circuit 2 would shunt the odd-group controllers entirely and pass through the contacts relay E in the even-group controllers in series corresponding to the contacts E5—E6 of controller I of Figure 4.

Vehicles which are forced to stop at street B and which after starting again proceed at ordinary speed will be assured right of way through adjacent protected intersections, as C, since current to energize relay G of the controller at C cannot flow until cam-shaft 21 of the controller at B has rotated from its rest position to the half-way or 180 degree point, where its cam Q has caused contacts Q1 and Q2 to engage. Relay G of each even-controller is thus energized through wire 3 and permits its controller to operate, if meanwhile a vehicle has actuated its detector, but in this time vehicles stopped at B should have passed through C. Right of way is returned to street A at B (odd) at the 180 degree point about the same time that contacts Q1, Q2 close to permit shift of right of way from street A upon actuation in street C (even). The time cycle is so arranged that the time for one half revolution of shaft 21 is approximately equal to the time of travel of vehicles between streets B and C. Thus vehicles on street A starting at street B at the 180 degree point will arrive at street C at the zero point when right of way returns to street A at C and the end of the group of vehicles proceeding along street A from B will have passed C at the 180 degree point when shift of right of way from street A can occur again at the intersection of streets A and C. Obviously if there has been no actuation in the side street, right of way will remain with the artery traffic regardless.

Controllers in the odd-group as they pass the 180 degree point in their cycles by the contacts of cam Q allow controllers in the even-group which have been actuated to yield right of way to their respective side streets, and even-controllers operate similarly to allow the odd-controllers to release. As the amount of traffic increases, periods when all the controllers are in their respective rest positions simultaneously, become less and less frequent, consequently the influence of the two series permissive co-ordination circuits under these conditions becomes minimized, and operation of the signals becomes more dependent on the co-ordinating impulses of the zero degree cam R and the 180 degree cam Q circuits.

With further increasing traffic the co-ordinating effect of the system becomes still more dominant, and with regular and frequent side street detector actuation, the apparatus approaches a fixed-time progressive cycle, in which side streets of the odd-group have right of way, then streets of the even group, the total length of the cycle having been determined principally from the time required for the average vehicle to cover the distance between adjacent intersections as for example twice the travel time.

Vehicles proceeding along the artery, having once fallen into a moving platoon of traffic, can proceed through the entire series of intersections at a certain speed without stopping, thus gaining full advantage of the progressive phase displacement of the signals. The advantage of co-or-

minated progressive handling of artery traffic in heavy traffic conditions does not impose unnecessary delay to side street vehicles in light traffic periods, since in the latter periods right of way can readily be allowed them promptly upon actuation of the detectors, for a large part of the time.

Thus among others, the several objects of the invention as specifically brought out above are achieved. It is appreciated that numerous changes in the construction or rearrangement of the parts, such as a substitution of disks and wipers for the cams or other changes, might be resorted to without departing from the spirit of the invention as defined by the claims.

Having described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a traffic signal control system for a series of intersections of cross lanes with a common main lane the combination at each intersection of right of way signals and a traffic signal controller operable for governing transfer of right of way between the intersecting lanes, a traffic actuable means in the cross lane and connected thereto for operating the same on actuation and means functioning upon operation of the traffic actuable means at one intersection for initiating a governing cycle over the other traffic signal controllers for determining definite periods only during which such transfer of right of way to their respective cross lanes can be made by said other controllers.

2. In a traffic signal control system for a series of intersections of cross lanes with a common main lane the combination of right of way signals and a traffic signal controller adapted to be operated for governing transfer of right of way between main and cross lane through a cycle and traffic actuable means connected thereto at each intersection for operating the same on actuation, and means functioning upon operation of the traffic actuable means at one intersection for initiating a governing cycle over the traffic signal controllers at the other intersections for determining definite periods only during which such transfer of right of way to any cross lane can be made in response to actuation of the traffic actuable means until the first controller has passed through a predetermined part of its cycle.

3. In a traffic control system for a plurality of intersections of cross lanes with a main traffic lane, the combination of a right of way indicating means, one at each intersection, traffic actuable devices in the cross lanes, control mechanism for operating said indicating means at each intersection normally to display right of way to the main lane, and upon operation of an actuable device, to transfer right of way to the associated cross lane, and means operative upon such a transfer of right of way to prevent any other control mechanism from transferring right of way to its associated cross lane in response to actuation therein.

4. In a traffic control system for a plurality of intersections of cross lanes with a common main traffic lane including at each intersection the combination of right of way indicating means, a traffic actuable device in the cross lane, control mechanism for operating said indicating means to normally display right of way to the main traffic lane and upon operation of its associated actuable device to transfer right of way to its cross lane, and means forming a part

of each control mechanism and operative upon transfer of right of way to the cross lane by the control mechanism to prevent for a predetermined period the transfer of right of way by other control mechanisms to their respective cross lanes.

5. In a traffic control system for a plurality of intersections of cross lanes with a main traffic lane, the combination at each intersection of a right of way indicating means, a traffic actuable means in the cross lane, control mechanism for operating said indicating means to cause transfer of right of way to the cross lane in response to actuation of said traffic actuable means, said control mechanism having a position in its cycle in which the mechanism rests after right of way has been indicated to the main lane for a predetermined period, and means including a circuit closed when all control mechanisms are in their rest position and open at all other times operable only when said circuit is closed for permitting any of the control mechanisms to transfer right of way to its cross lane in response to operation of the traffic actuable means associated therewith.

6. In a traffic control system for a plurality of intersections of cross lanes with a main traffic lane, the combination at each intersection of a right of way indicating means, a traffic actuable means in the cross lane, control mechanism for operating said indicating means through a cycle to cause transfer of right of way to the cross lane and retransfer to the main lane and initiated into operation through said cycle in response to actuation of said traffic actuable means, said control mechanism having a position at the end of its cycle in which the mechanism rests after right of way has been indicated to the main lane for a predetermined period, and means including a circuit closed when all control mechanisms are in their rest position and for a further predetermined part of the cycle, and open at all other times and operable only when said circuit is open to prevent all the control mechanisms from being so initiated into operation and means in each control mechanism for maintaining such mechanism operated to the end of its cycle when so initiated.

7. In a traffic control system for a plurality of intersections of cross lanes with a common main traffic lane, the combination at each intersection of a right of way indicating means, a traffic actuable means in the cross lane, control mechanism for operating said indicating means to cause transfer of right of way to the cross lane in response to actuation of said traffic actuable means, said control mechanism having a position in its cycle in which the mechanism rests after right of way has been indicated to the main lane for a predetermined period, and means including a circuit interconnecting the several control mechanisms at the several intersections and having two conditions of operation, one for allowing any of said control mechanisms to transfer right of way to its cross lane in response to actuation of its cross lane actuable means, the other condition for preventing all of said control mechanisms from transferring right of way to their respective cross lanes in response to actuation of their associated actuable means, and means operable upon operation of the actuable means at any intersection to change said circuit from one condition to the other.

8. In a traffic control system for a plurality of intersections of cross lanes with a common

main traffic lane, the combination at each intersection of a right of way indicating means, a traffic actuable means in the cross lane, control mechanism for operating said indicating means to cause transfer of right of way to the cross lane in response to actuation of said traffic actuable means, said control mechanism having a position in its cycle in which the mechanism rests after right of way has been indicated to the main lane for a predetermined period, and means including a circuit interconnecting the several control mechanisms at the several intersections and having two conditions of operation, one for allowing any of said control mechanisms to transfer right of way to its cross lane in response to actuation of its cross lane actuable means, the other condition for preventing all of said control mechanisms from transferring right of way to their respective cross lanes in response to actuation of their associated actuable means, and means operable upon transfer of right of way to the cross lane by the control mechanism at one of the intersections to shift said circuit from said one condition to said other condition.

9. In a traffic control system for a series of intersections of cross lanes with a common main traffic lane, the combination of right of way indicating devices, control mechanisms for operating said devices thru a cycle of indications, and traffic actuable devices in the cross lane connected to the control mechanism for initiating operation of said mechanism, at each intersection, and a circuit for interconnecting the several control mechanisms and having two operative conditions, means operable when said circuit is in one of said conditions for energizing any control mechanism whose associated traffic actuable means is operated, and operable when said circuit is in the other condition to prevent initiation of operation of any of said control mechanisms, and means in each control mechanism operable when right of way has been indicated to the main lane for a predetermined or greater period to place said circuit in said one condition, and operable when one of said control mechanisms operates to transfer right of way to the associated cross lane to shift said circuit to said other condition.

10. A traffic signal control system for a series of intersections of cross lanes with a common main traffic lane and having at each intersection traffic right of way signal means, traffic actuable means in the cross lane, a traffic signal controller operable for normally according right of way through said signal means to the main lane, and upon actuation of the traffic actuable means transferring right of way to the cross lane, control means including a circuit interconnecting the several controllers to restrict to a predetermined time phase relationship when operable such transfer of right of way by said controllers, and means functioning only upon operation of any one of the controllers responsive to actuation of its associated traffic actuable means at one intersection for causing operation of said control means.

11. A traffic control system for a plurality of intersections of cross lanes with a common main lane including at each intersection, a right of way signal, a signal controller for operating when initiated said signal through a time cycle to accord and interrupt right of way to the intersecting lanes and traffic actuable means in the cross lane, circuit means including switch means associated with each controller and only operable

when all said switch means are closed to initiate operation of any controller in response to actuation of the associated traffic actuable means and means forming a part of said controller to operate its associated switch means as said controller operates through its cycle to control initiation of operation of the traffic signal controllers at the other intersection.

12. A traffic control system for a plurality of intersections of cross lanes with a common main lane including at each intersection, a right of way signal, a signal controller for operating when initiated said signal through a time cycle to accord and interrupt right of way to the intersecting lanes and traffic actuable means in the cross lane, circuit means including switch means associated with each controller and only operable when all said switch means are closed to initiate operation of any controller in response to actuation of the associated traffic actuable means and means operated by operation of said controller in a part of its cycle to open the switch means at such intersection whereby initiation of operation of the signal controller at the other intersections is prevented.

13. A traffic control system for a plurality of intersections of cross lanes with a common main lane including at each intersection, a right of way signal, a signal controller for operating when initiated said signal through a time cycle to accord and interrupt right of way to the intersecting lanes and traffic lanes and traffic actuable means in the cross lane, circuit means including switch means associated with each controller and only operable when all said switch means are closed to initiate operation of any controller in response to actuation of the associated traffic actuable means and means operated by operation of said controller to open the switch means at such intersection for a predetermined period whereby initiation of operation of the signal controllers at the other intersections is prevented for such period.

14. In a traffic control system for a plurality of intersections of cross lanes with a common main traffic lane including at each intersection the combination of right of way indicating means, a traffic actuable device in the cross lane, control mechanism for said indicating means normally causing the latter to display right of way to the main traffic lane and when conditioned operating in response to actuation of its associated cross lane actuable device to transfer right of way to the cross lane and back to the main lane in a time cycle, said control mechanism having a position in its cycle in which the mechanism rests after right of way has been indicated to the main lane for a predetermined period, and means interconnecting the several control mechanisms and including a circuit closer in each control mechanism closed by the control mechanism in its rest position and open at all other times in its cycle, operable only when all said circuit closers are closed for so conditioning any one of the control mechanisms to transfer right of way to its cross lane and back in response to operation of the traffic actuable means associated therewith.

15. In a traffic control system for a series of intersections of cross lanes with a common main traffic lane, the combination at each intersection of a right of way indicating device, a control mechanism for operating said device through a cycle of indications when energized, and traffic actuable means in the cross lane connected to the control mechanism, and means including a

circuit interconnecting the several control mechanisms for initially energizing when closed any control mechanism whose associated traffic actuable means is actuated and for preventing when open initial energization of any of said control mechanisms, said circuit including in series a circuit breaker in each control mechanism, and means in each control mechanism for closing said circuit breaker to close said circuit in a certain part of its cycle and for opening it in a different part of said cycle, and means in each control mechanism for maintaining such control mechanism energized to the end of its cycle after it has been initially energized by said circuit means.

16. A traffic signal control system for a series of intersections of cross lanes with a common main traffic lane, including in combination, right of way signals and a traffic signal controller adapted to be operated for governing transfer of right of way between main and cross lanes for each intersection said controllers being assembled into two groups, traffic actuatable means in the cross lane at one intersection, and means functioning upon operation of said actuatable means to operate the controller at said one intersection and initiate a cycle of control over said two groups of controllers, during the first part of which cycle controllers of one group cannot transfer right of way to their cross lanes and during the second part of which cycle controllers of the second group cannot transfer right of way to their cross lanes.

17. A traffic signal control system for a plurality of intersections of cross lanes with a common main traffic lane including at each intersection a right of way indicating means and a right of way transferring controller therefor, a traffic actuatable device in the cross lane and connected to said controller, said controllers at said intersections assembled into two groups, each controller of both groups having a rest position and another position one-half cycle from the rest position, each controller normally indicating right of way to the main lane and adapted to accord right of way to its cross lane upon actuation of the traffic actuatable device connected thereto, and means operable upon according of right of way to a cross lane by a controller of one group to initiate a cycle of control in which all other controllers of that group are prevented from transferring right of way in response to operation of their respective cross lane traffic actuatable devices except when said first controller is in its rest position, and in which all controllers of the second group are prevented from transferring right of way except during the half-cycle position of said first controller.

18. In a traffic signal control system for a plurality of intersections of cross lanes with a common main traffic lane, at each intersection a traffic right of way signal and a traffic signal controller for transferring right of way between the main and cross lanes in a cycle, a traffic actuatable device in the cross lane for governing operation of said traffic signal controller, said controllers being assembled into two groups and each of said controllers having a position in its cycle in which the controller rests after right of way has been indicated to the main lane for a predetermined period and having another position substantially a half cycle away from the rest position, means including a circuit closed in the rest position for permitting controllers of one group to respond to actuation of their respective actu-

atable devices, and means including another circuit closed in the half-cycle position to permit controllers of the other group to respond to actuation of their respective cross lane actuatable devices.

19. A traffic signal control system for a plurality of intersections of cross lanes with a common main traffic lane including at each intersection a traffic right of way signal and a traffic actuatable device associated with the cross lane, a traffic signal controller for governing the display of right of way signal indications to the intersecting lanes through a cycle in response to actuation of said device, said controller having a rest position in its cycle after right of way has been displayed to the main lane for a predetermined time and having another position substantially a half cycle from the rest position, the controllers being assembled into two groups and having a circuit connecting one of said controllers with each of one group of said controllers to enable when closed each of said controllers of said one group to respond to actuation of their respective traffic actuatable devices, and a second circuit connecting said one of said controllers with each of the second group of said controllers to enable when closed each of said controllers of said second group to respond to actuation of their respective traffic actuatable devices, and means effective in the rest position to close said one circuit, and means effective in the half cycle position to close said second circuit.

20. A traffic signal control system for a plurality of intersections of cross lanes with a common main traffic lane including at each intersection a traffic right of way signal, a traffic actuatable device associated with the cross lane and a traffic signal controller for governing the display of right of way signal indications to the intersecting lanes through a cycle in response to actuation of said device, each said controller having a rest position in its cycle after right of way has been displayed to the main lane for a predetermined time and having another position substantially a half cycle from the rest position, the controllers being assembled into two groups, means including a circuit connecting with each of said controllers of one group to enable when energized any of the latter said controllers to respond to actuation of their respective traffic actuatable devices, means including a second circuit connected with each of the controllers of the second group to enable when energized any of said controllers of said second group to respond to actuation of their respective traffic actuatable devices, means operated by each controller of said one group in its half cycle position only to energize said second circuit, means operated by each of the controllers of said second group in its half cycle position only to energize said one circuit, means including contacts in each controller of both groups and a series circuit through said contacts to energize said one circuit when said series circuit is closed, means in each controller to close said contacts only in its rest position to close said series circuit, means including further contacts in each controller of said one group and a series circuit through said further contacts connected with the first mentioned series circuit to energize said second circuit when the first and second said series circuits are concurrently closed, and means in each controller of said one group to open said further contacts only in response to actuation of the associated traffic actuatable device to interrupt energization of said second

circuit by the first series circuit when such last mentioned actuation occurs in the rest position.

21. In a traffic signal control system for a series of intersections of cross lanes with a common main lane having right of way indicating means at each intersection, the combination at one intersection of a traffic signal controller operable for governing transfer of right of way between main and cross lanes by said indicating means and a traffic actuatable means in the cross lane connected to said controller for governing operation of said controller, a second traffic signal controller at a second intersection operable for governing transfer of right of way between main and cross lanes by said indicating means and a second traffic actuatable means connected thereto and in the cross lane at said second intersection for governing operation of said second controller, a third traffic signal controller at a third intersection operable for governing transfer of right of way between main and cross lanes by said indicating means, traffic actuatable means connected thereto and in the cross lane at said third intersection for governing operation of said third controller, each said controller having energizing means adapted when rendered effective to so operate its associated controller in response to actuation of its associated traffic actuatable means, and means at the first intersection to initiate by operation of the first controller a control cycle in which the energizing means for the traffic signal controller at the second intersection is rendered effective to cause on

such actuation transfer of right of way to its cross lane during only one part of the cycle, and in which the traffic signal controller at the third intersection is rendered effective to cause on such actuation transfer of right of way to its cross lane only during a different part of the cycle.

22. A traffic control system for a plurality of intersections of cross lanes with a common main lane and having at each intersection a right of way indicating means, control mechanism for operating said means to accord and interrupt right of way to the intersecting lanes thru a time cycle and including a camshaft with associated cams and contacts connected to operate said means, and driving means for the camshaft, a circuit interconnecting all said control mechanisms including in series a pair of cam-operated contacts in each mechanism for controlling energization of the several driving means to start the latter through said cycle, and a cam mounted on said camshaft for operating said last named contacts to interrupt said circuit within a predetermined part of said cycle after starting of the driving means therein and maintain said circuit interrupted for a further predetermined part of the cycle, and to thereupon close the same and means in each control mechanism operating whenever operation of said mechanism has been started to maintain energized the driving means of said mechanism through a complete cycle until said circuit is again closed.

EDWARD H. EAMES.

117-237
Patent No. 2,122,410.

CERTIFICATE OF CORRECTION.

July 5, 1938.

EDWARD H. EAMES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 35, for "plane" read plan; page 5, first column, line 8, for "machine" read controller; page 8, first column, line 47, claim 17, for "connectd" read connected; page 9, second column, line 5, claim 21, for "trainsfer" read transfer; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of November, A. D. 1938.

Henry Van Arsdale

Acting Commissioner of Patents.

(Seal)

117-337
Patent No. 2,122,410.

CERTIFICATE OF CORRECTION.

July 5, 1938.

EDWARD H. FAMES.

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