

Jan. 30, 1940.

G. W. THOMPSON ET AL

2,188,731

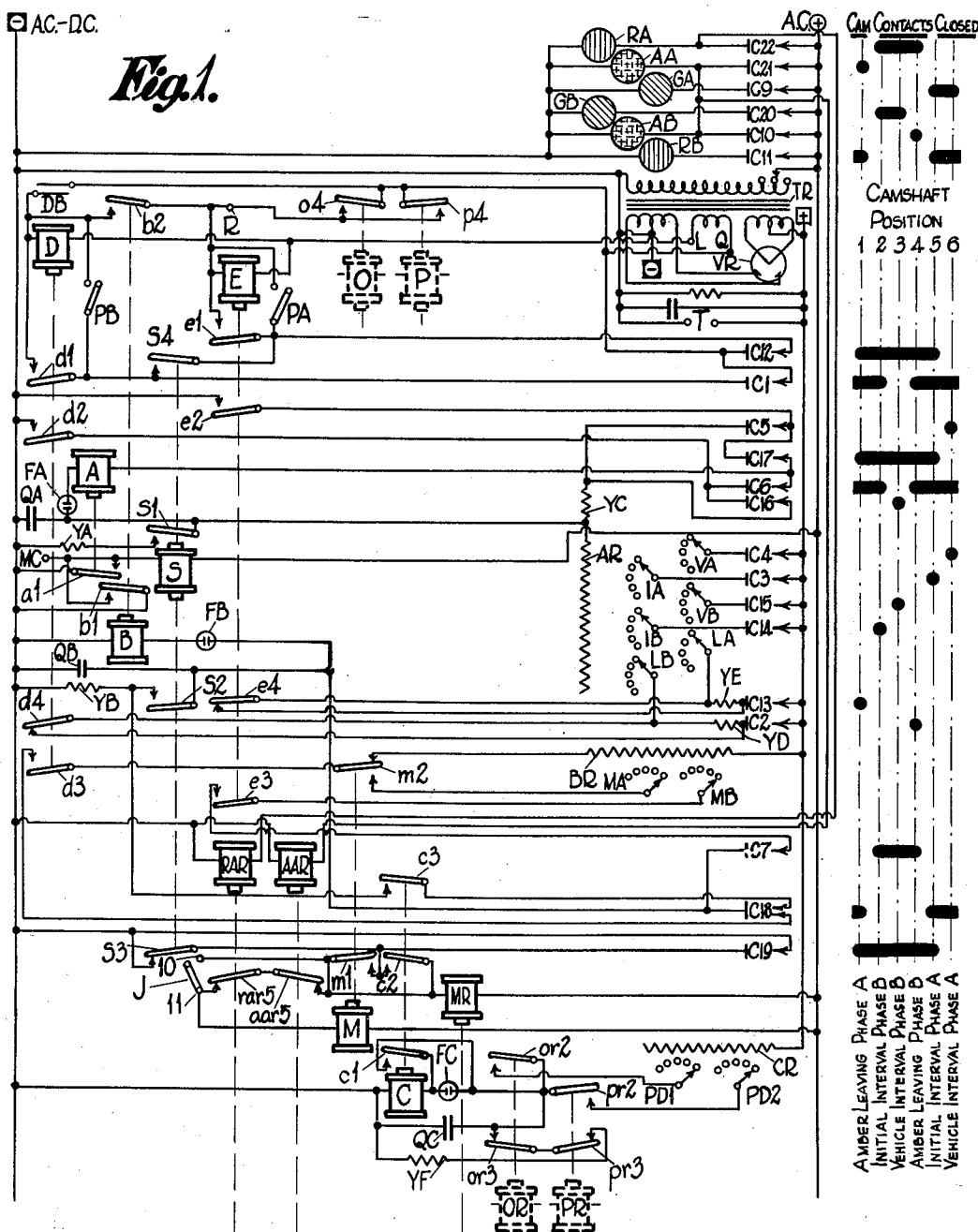
TRAFFIC CONTROL SYSTEM

Filed March 24, 1937

3 Sheets-Sheet 1

AC-DC.

Fig. 1.



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3 Sheets-Sheet 2

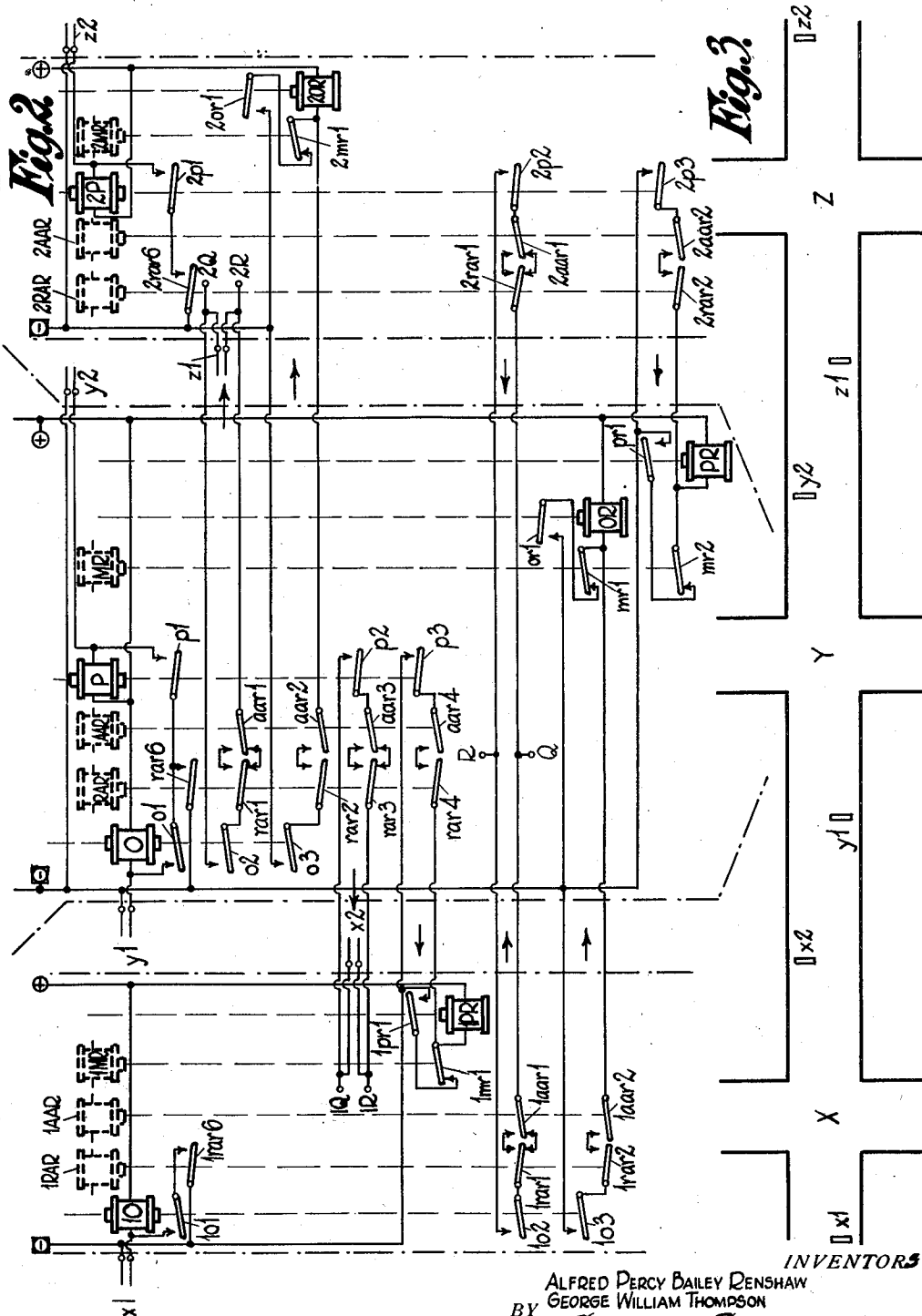


Fig. 2

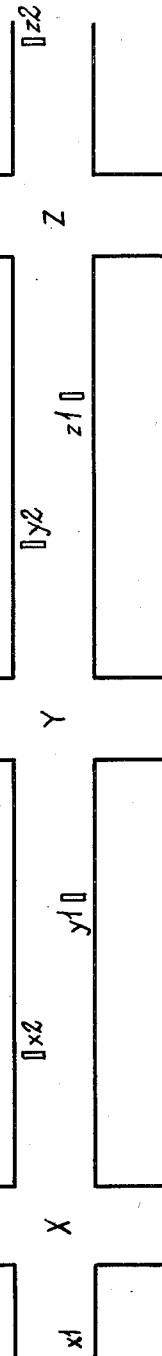


Fig. 3

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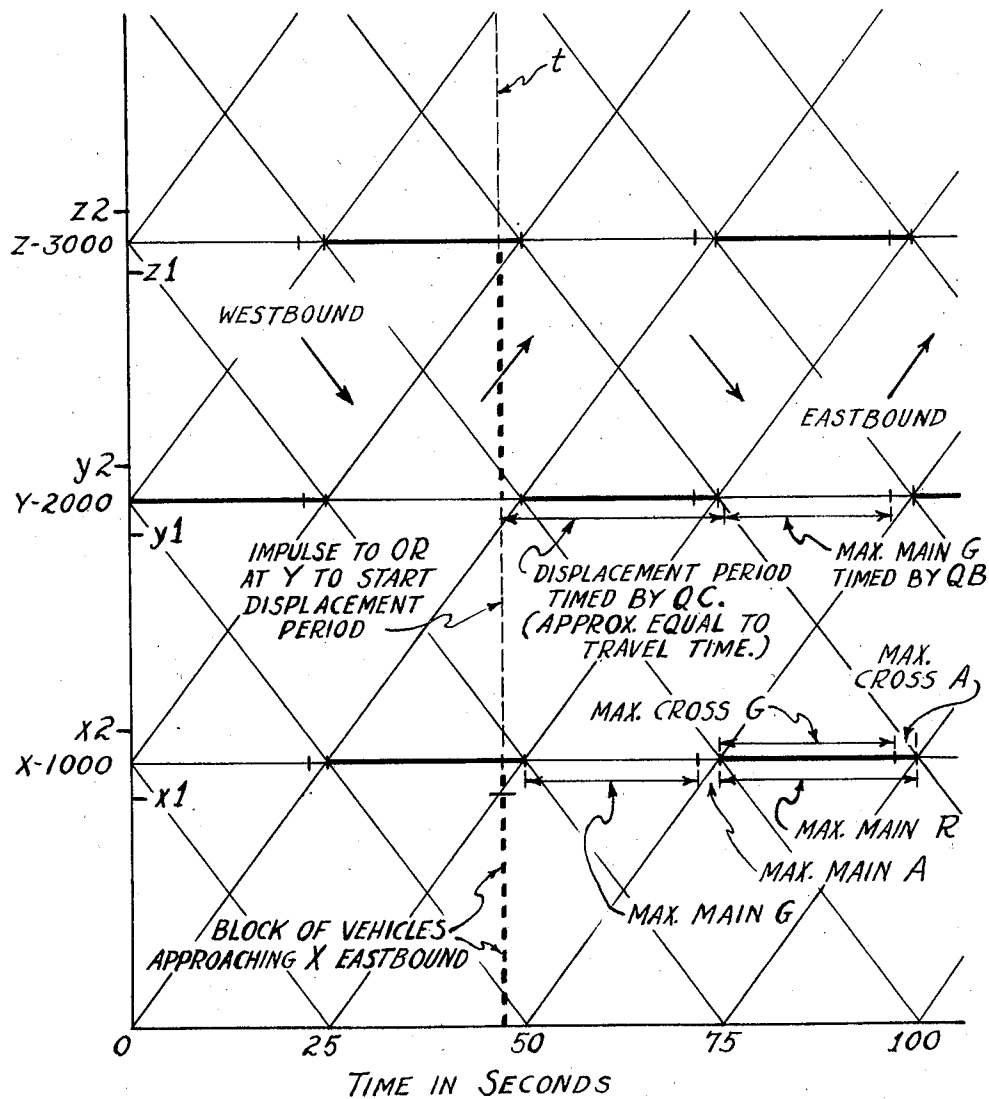
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Fig. 4.

DISTANCE
IN FEET



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2,188,731

TRAFFIC CONTROL SYSTEM

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15 Claims. (Cl. 177—337)

The present invention relates to traffic control signals for use at road crossings or the like and is more particularly concerned with traffic control systems of the progressive type by means of which a number of controllers located at successive intersections on a main road may be regulated in a certain phase relationship to each other so that if the average speed of the traffic is known it is possible to arrange the signals so that main road traffic passing the first intersection will not be held up at succeeding intersections. The invention moreover is particularly concerned with systems in which under light traffic conditions the operation of the signals may be controlled in accordance with the density of the traffic by the employment of vehicle detectors located in the roadway.

Arrangements have already been suggested in which, while traffic is light, the signals at each intersection are controlled in accordance with the traffic thereat without relationship to the traffic at other intersections, but in which when the traffic on the main road becomes so heavy as to be substantially continuous, that is to say the controllers become in effect fixed time controllers working on their maximum timing limits, the timing of the signals is automatically brought under control of a master controller which thereupon imposes a rigid plan according to which the signals are operated in a related sequence so as to ensure that the traffic on the main road shall be subject to a minimum amount of delay when passing through the series of intersections. For example the phase relationship between the signals at two adjacent intersections may conveniently be such that the main road is opened at one of the intersections a predetermined interval before it is opened at the other intersection which interval is sufficient for a vehicle travelling at a predetermined speed to travel from one intersection to the other.

In the form of such a system disclosed in British Patent No. 403,732, and the corresponding convention Patent 2,129,446, a master timer is employed from which separate pairs of conductors radiate to the controllers at each intersection for the purpose of regulating their time periods in relation to one another. In the case of continuous main road traffic with traffic waiting on the cross roads, even though the maximum timing condenser in any controller becomes fully charged it is impossible for it to discharge through the associated neon lamp and change the right-of-way until a pulse is received from the master timer. Thus when the maximum time limit

is reached the signals will not immediately change but rather the circuit will be put into a condition such as to be responsive to the regulating pulses from the master timer. In practice in an installation of this type it has been found necessary to reduce the main road maximum period of each controller so that the main road will not become congested before the master controller pulses become effective and with this arrangement the traffic can more easily come into line with the predetermined progressive plan. Unfortunately however during light traffic conditions there will be a correspondingly greater possibility of a controller at any one intersection reaching the maximum time limit due to a small block of traffic and therefore being responsive to a possible pulse from the master controller which would in this case cause unnecessary interference. Furthermore during periods of substantially continuous traffic the arbitrary termination of right-of-way periods by the master controller takes no account of the traffic conditions at any particular moment and proves inflexible and somewhat expensive in practice and the chief object of the present invention is to effect an improvement in the operation in this respect.

According to the invention in a traffic control system employing a plurality of sets of signals located at adjacent intersections, interlinking circuits are provided between successive controllers which enable the maximum timing arrangements at each to be started in operation progressively, the necessary displacement of the start signals being secured by an additional timer in each individual controller.

The invention will be better understood from the following description of one method of carrying it into effect, reference being had to the accompanying drawings comprising Figs. 1 to 4. Fig. 1 shows the equipment of an individual controller, part of which is shown separately in Fig. 2. Fig. 2 also shows typical arrangements of interlinking between three successive controllers associated with intersections designated X, Y, and Z which are shown in diagrammatic form in Fig. 3. Fig. 4 shows the effect of interlinking in a time distance diagram of progressive traffic movement through the three intersections, X, Y, and Z.

It should be explained generally that the controller illustrated in Fig. 1 is of the type now well-known, and shown in the British patent previously referred to in which a number of contact springs are operated by a cam shaft which is rotated step by step by means of a solenoid. The

solenoid is operated at suitable intervals which are determined by the time taken to charge a condenser through a high resistance until it attains the striking voltage of a neon or similar gas discharge tube whereupon the tube flashes and a relay in series therewith is operated to bring about the advance of the cam shaft to the next position.

The controller shown makes use of the usual arrangement of two timing circuits one of which is controlled from the vehicle detectors so that if traffic continues to arrive on the road possessing right of way the condenser is intermittently discharged and thus an extension of the right of way period is obtained. In order however that one road may not hold right of way indefinitely if traffic is waiting on the other road, the second timing circuit is provided and in this the condenser is charged steadily and cannot be discharged by further operations of the detector. Consequently if a detector has been operated in the blocked road this second timing circuit sets a maximum value to the period which a vehicle thereon will have to wait. In the arrangement illustrated the improved working according to the invention is obtained by the provision of a third timing circuit which is set into operation on reception of a call extended during the main road red-amber period of the preceding intersection to indicate that traffic is about to be released from that intersection. This timing circuit functions to measure off a time approximating that required for vehicles to traverse the distance between the two intersections and when it completes timing this predetermined interval, a circuit is completed to commence timing the maximum period in order that the released block of traffic may proceed without interference to the intersection ahead where the process is repeated. It may be arranged that unless the signals at the called intersection are giving right of way to the main road the linking pulse from the calling intersection is lost, or alternatively, that the pulse is stored no matter what the signal indication is at the time of reception of the pulse; the relative merits of the two arrangements will be more fully appreciated from the ensuing detailed description.

Considering now the detailed operation of the circuit, it is assumed that the controller is fed from alternating current mains connected to the transformer TR which is conveniently provided with suitable tapping points to suit different mains voltages. From the outer secondary windings of this transformer the valve rectifier VR is fed and this supplies direct current to the terminals marked plus and minus, suitable smoothing devices being employed. From the terminals L and Q of the inner secondary winding alternating current at a low voltage is obtainable for use in the vehicle detector circuit. Normally one conductor of the mains will be connected to earth and the terminals concerned are indicated by a minus sign in a circle and square. The terminals marked T are provided for convenience in testing.

The table at the right hand side of Fig. 1 shows by heavy black dots and bars the shaft positions in which the various cam contacts are closed. It will be understood that in the absence of traffic the shaft will be standing in either position 3 or position 6 corresponding to the so-called vehicle interval position for either phase B or phase A respectively, the latter being associated with main road traffic and the former with cross road traffic.

Referring now to Figs. 2 and 3, Fig. 3 shows a main road in diagrammatic form while Fig. 2 shows the method of interlinking between the controllers at the intersections X, Y and Z. In the arrangement shown it will be assumed that there is a clear stretch of main road leading inwards towards the intersections X and Z and interlinking therefore will only be required between X, Y and Z. In addition to the interlinking of the controllers so that the maximum timing circuits of each successive controller can be started up progressively, facilities for repeated detector impulsing are also provided on the lines disclosed in British Patent 446,288, and the corresponding convention Patent 2,145,031. It will be understood that the controllers at each intersection are substantially identical, certain interlinking equipment however not being required at the outer intersections X and Z.

Referring now to Figs. 1 and 2, it will be assumed that the diagram comprising Fig. 1 when arranged in conjunction with the portion of Figure 2 between the center pair of dotted lines represents the controller at intersection Y and that the cam shaft is standing in position 3 giving right of way to cross road traffic or phase B. Traffic arriving on the cross road will intermittently operate the detector DB, Fig. 1, and hence relay D, and this relay at armature d2 will shunt the condenser QA over resistance YC since cam contacts C16 are closed. The charging circuit for condenser QA extends from positive over cam contacts C15 and the phase B vehicle interval adjusting switch VB which is suitably wired to the tapings of the common resistance AR.

Assuming now that a vehicle operates phase A detector y1 or y2, Fig. 3, relays O or P, Fig. 2 will be operated and at armatures o4 or p4, Fig. 1, relay E will be energized and thereupon lock by way of cam contacts C12 and armature e1. At armature e2 relay A and the neon tube FA are connected across condenser QA by way of cam contacts C17 so that if the potential of the condenser rises sufficiently relay A will operate. Furthermore at armature e3 a charging circuit is completed by way of contacts C7, the phase B maximum adjusting switch MB and the common resistance BR for the condenser QB.

If now a break occurs in the phase B traffic of sufficient length to permit the striking voltage of the neon lamp FA to be reached or should the maximum condenser QB be charged to the striking voltage of the neon lamp FB, either relay A or relay B will be operated to energize the solenoid S which in turn will advance the cam shaft to position 4. The solenoid contacts S1 and S2 operate momentarily to discharge condensers QA and QB by way of the resistances YA and YB respectively so as to ensure that they start the next timing period with no residual charge. In position 4 cam contacts C2 are closed and the charging circuit for condenser QA therefore extends over the phase B amber adjusting switch LB. If the stepping of the cam shaft has been brought about by relay B due to a change on maximum, armature b2 and cam contacts S4 will have ensured that relay D still remains energized and consequently, with contacts d4 open the charging circuit will now include resistance YD which gives an extended amber period to give time for cross traffic to clear the intersection. The continued energization of relay D ensures that right of way shall return to phase B without any further detector operation so as to release any vehicles which may have been stopped after

passing the detector. If relay D is not operated however, resistance YD is short circuited by contacts *d4* and the amber period is correspondingly shortened. It will be appreciated that some degree of extension of the period is obtained if the detector DB is crossed by a vehicle during the amber period.

When the cam shaft advances to position 5 after the expiration of the amber period, charging of the condenser 2A takes place over cam contacts C3 and the phase A initial interval adjusting switch IA and at the end of the period determined thereby, the cam shaft steps to position 6. The length of the initial interval cannot be affected by the operation of either of the detectors. The cam shaft is now in the vehicle interval position for phase A and the locking circuit for relay E will be opened at cam contacts C12. Phase A traffic will now intermittently operate relay E and if there are any waiting vehicles on phase B relay D will be operated and locked up by way of cam contacts C1 and contacts *d1*. Charging circuits will thereupon be completed for condenser QA over cam contacts C4 by way of the phase A vehicle interval switch VA and for condenser QB by way of cam contacts C18, armatures *d3* and *m2* and the entire resistance BR. Should the density of the traffic be such as to prevent condenser QA from charging sufficiently, the changeover of the signals will be dependent on the maximum timing condenser QB but since the whole of resistance BR is included in the maximum timing circuit, the maximum period will be exceedingly long. Normally however the operation of relay M will at armature *m2* connect the ordinary maximum adjusting switch MA in circuit as will be described subsequently.

It will be understood that the signalling lamps GA, AB, RB, GB, AA and RA are operated over cam contacts C9, C10, C11, C20, C21 and C22 respectively in a manner which will be readily followed from the cam contact operation table. The strap between the amber lamps AA and AB is employed to give an amber indication to both phases immediately prior to the change to green.

The switches PA and PB associated with the detector circuits are so-called arterial switches and the closing of one of these switches will ensure that right of way will return to the associated phase in the absence of traffic on the other phase. The effect of these switches is to put in a call but not to produce any extension in the absence of traffic. The manual control terminal MC may be connected via a push button to enable stepping of the solenoid to be effected manually.

Referring now to Figs. 2 and 3 it will be assumed that the controllers at intersections X, Y and Z, all of which are similar to that for intersection Y shown in Fig. 1 and part of Fig. 2, are all operating individually under light traffic conditions and that the controller at intersection X shows red to the main road, i. e., the cam shaft is in position 3. Assume now that a block of traffic approaches intersection X along the main road in the direction left to right and thereupon the leading vehicle will actuate the detector *x1* and operate relay 10. It should be mentioned that in order to distinguish the references to the various controllers the prefix 1 is added to the designation of any relay in the controller at intersection X and the prefix 2 to relay designations for the controller at intersection Z. Since relay 1RAR is operated in parallel with the lamp RA

for intersection X, relay 10 will be locked over armature 1ara6. Armature 1o2 thereupon prepares a repeat detector impulse circuit and armature 1o3 prepares a circuit for relay OR in the Y controller while armature 1o4 (see o4 in Fig. 1) operates the phase A road relay 1E in the X controller. Relay 1E locks up in the manner previously described and prepares to change the right of way from phase B to phase A when a suitable gap in the phase B traffic occurs or at the end of the phase B maximum period.

When the X controller subsequently steps to position 4, the amber lamps for both phases will be lighted the phase A red lamp remaining alight and consequently the block of traffic will prepare to commence movement. Relay 1AAR will now be operated in parallel with the phase A amber lamp and consequently at armatures 1aar1 and 1aar2 circuits will be completed to the controller at intersection Y.

Armature 1aar1 completes the repeat detector impulse circuit which extends a loop across terminals Q and R and thereupon operates relay E in the Y controller and thus prepares this controller in advance of the block of traffic at X approaching Y. When the controller at intersection X subsequently changes over to positions 5 and 6 giving right of way to phase A traffic, relays 1AAR and 1RAR will be released and further vehicles passing over the detector *x1* will impulse relay 10 which thereupon puts in calls at both the X controller and also the Y controller over the back contacts of these relays. This helps to keep the important main road traffic moving with the minimum of stoppages and to prevent the possibility of blocking back over a preceding crossing. The single pulse stored during the red period and transmitted during the red-amber period caters for a condition where for example there are only such a small number of vehicles waiting at intersection X that they can be accommodated between the detector *x1* and the stop line at the intersection. If this arrangement were not made, when they received right of way no repeat impulse would be transmitted to the succeeding intersection unless a further vehicle passed over detector *x1* and the traffic might therefore be held up at intersection Y.

Armature 1aar2 completes an operating circuit for relay OR in the Y controller and thereupon this relay locks by way of armatures *or1* and *mr1*, and at armature *or2*, Fig. 1, a circuit is completed by way of a suitable tapping on resistance CR and the phase displacement timing switch PD1 to charge condenser QC. This timing circuit is adjusted to cause the neon lamp FC to strike after a period which is sufficient for a vehicle to travel at the predetermined speed from intersection X to intersection Y. Assuming that the switch J between terminals 10 and 11 is open as shown in Fig. 1 after the lapse of the predetermined interval the lamp FC will strike and thus operate relay C at the same time as the first vehicle of the block of traffic should reach the detector *y1*. Should the Y controller not be showing green to the main road, either relay RAR or both relays RAR and AAR will be operated in parallel with the associated phase A signal lamps and there will thus be no circuit for relay M as *rar5* or *aar5* or both will open but a circuit will be completed for relay MR by way of solenoid contacts S3 and armature *c2*. Armature *mr1*, Fig. 2, thereupon opens the locking circuit of relay OR which releases and at armature *or2* opens the locking circuit of relay C which was previously

held by way of armatures *cl* and *or2*, switch *PD1* and resistance *CR*, while armature *or3* shunts condenser *QC* by way of resistance *YF* and armature *pr3*. Relay *C* upon releasing in turn releases relay *MR* and this portion of the controller is thus restored to normal. In this case the interlinking will be ineffective and the phase A traffic will have to wait until it receives right of way in the normal course; the waiting period is reduced to a minimum however since a repeated detector impulse will already have been stored when right of way was taken from the main road.

In case however the *Y* controller is showing green to the main road at the conclusion of the phase displacement timing period, relay *C* upon operating will operate relay *M* in addition to relay *MR* and this relay will lock up by way of armatures *rar5*, *aar5*, *m1* and solenoid contacts *S3*. Armature *c3* discharges condenser *QB* over resistance *YB* and contacts *C13* and when relay *C* is subsequently released as described before, relay *M* remains locked and at armature *m2* completes the phase A maximum timing circuit by way of the adjusting switch *MA* and a suitable tapping on resistance *BR*. This maximum timing period has therefore been started a predetermined interval after the traffic was released from intersection *X*.

Though the method of interlinking between two intersections has now been described in detail it will be desirable to consider the three intersections as a whole in order to appreciate fully the working of this system. Considering the main road which is shown in Fig. 3, it will be realized that in the absence of cross traffic and after the passage of a vehicle along the main road the controllers at each intersection will be showing green to the main road. Under this condition there is no maximum interlinking since the interlinking pulses are sent only on red-amber and it will be understood that this arrangement is satisfactory since if there is waiting cross traffic the repeat detector impulsing facility will maintain right of way for the main road until suitable gaps occur in the main road traffic. Should right of way be taken away from the main road at one or more intersections and the main road traffic become so heavy as to be substantially continuous, the traffic will in effect be divided into "blocks" the size of which is dependent on the speed of the traffic and the length of the maximum period at any controller. These "blocks" will be passed forward to each intersection in turn where the maximum period is arranged to commence when the leading vehicle of the "block" reaches the intersection and where the maximum period terminates when the last vehicle of the block has passed through.

The effect of the maximum interlinking in producing progressive movement through the series of intersections is illustrated in Fig. 4 which shows a distance time diagram of progressive traffic movement through the intersections *X*, *Y*, and *Z* as provided by the interlinking under maximum traffic conditions. The Fig. 4 diagram assumes the intersections *X*, *Y* and *Z* to be 1000 ft. apart and also assumes a steady speed of traffic at 40 ft. per second or about 27 miles per hour. The diagram also assumes that the maximum time settings of adjustment switches *MA* and *MB* in the several controllers at *X*, *Y* and *Z* are all set uniformly to provide about 22 seconds of green, 3 seconds of amber, and 25 seconds of red on each street. The adjustment switches *PD1* and *PD2* under these circumstances may be

set, for example, to provide a displacement time period of about 28 seconds as timed by condenser *QC*, which is about equal to the time required for a vehicle to travel from the detector *x1* at the *X* intersection to the *Y* intersection.

It will be noted in this distance time diagram that traffic proceeding eastbound through intersections *X*, *Y*, and *Z* in series is illustrated as proceeding diagonally upward to the right, and westbound traffic is illustrated as proceeding diagonally downward to the right. The position of a block of eastbound vehicles is illustrated along a time line *t* taken for example at about 47 seconds on the time scale. The block of vehicles approaching intersection *X* appears as a series of short heavy vertical lines, and it will be noted that the leading vehicle in the block is illustrated as having just passed over detector *x1* at about the beginning of the amber period of the cross road at intersection *X*. Above this point along line *t* the arrow indicates the transmission of an impulse to relay *OR* at intersection *Y* to start the timing of the displacement period by charging of condenser *QC*. The displacement period at *Y* extends toward the right to about 75 seconds at which point the green signal will have just been returned to the main road at *Y*, assuming that the cross road green signal was held to a maximum. The maximum main road green period is illustrated as starting at termination of the displacement period and extending to about 97 seconds where the amber signal would be displayed.

The diagram of Fig. 4 shows the main road red periods as heavy horizontal lines, and the main road green (and amber) periods appear as the spaces along the intersection lines between the heavy horizontal lines. It will be appreciated that all these time periods appearing on the diagram are based on maximum traffic flow, the division of these maximum signal periods being indicated along the line for intersection *X* as representative of all the intersections.

In order to avoid unduly complicating the diagram the effect of westbound traffic in starting the displacement period is not illustrated but such traffic approaching from above intersection *Z* would actuate detector *z2* to send an impulse ahead to relay *PR* at intersection *Y* to start timing of displacement period for *Y* in similar fashion to the illustration shown for eastbound traffic. If impulses were received from both *Z* and *X* then the displacement period would be timed as described above in accordance with the shortest time setting for the charging of condenser *QC*. In the present instance since the speed of traffic is assumed the same in opposite directions and the maximum traffic conditions are illustrated the displacement period at *Y* would be initiated simultaneously by eastbound traffic approaching at *X* and westbound traffic approaching at *Z* and the time setting for charging condenser *QC* would be the same for both eastbound and westbound traffic so that the effect would be the same as if only eastbound traffic started the displacement period as illustrated in the diagram.

If the cross traffic were to decrease so as to require a minimum of 12 seconds at intersection *Y* alone for example the main red period just to the right of the line *t* in Fig. 4 would terminate earlier at about 62 seconds. Except for eastbound vehicles which may have turned into the main road at intersection *X* or westbound vehicles which may have turned into the main road

at intersection Z and except for main road traffic proceeding above the assumed speed, this early termination of the main road red signal at Y will have no effect on the movement of eastbound traffic, since eastbound traffic proceeding at normal speed would arrive at about 75 seconds. The early termination will, of course, assist in clearing the vehicles which may have turned into the main road. If traffic conditions changed so that the cross road traffic at all the intersections decreased and required a minimum period of only about 12 seconds for example the resulting shortening of the main road red period would allow main road traffic to start earlier at each of the intersections and with the same maximum and same displacement based on the same traffic speed, the effect would be to shorten the total signal cycle. A single vehicle turning into the main road at intersection X and proceeding eastbound will have no influence on the maximum interlinking between X and Y, but such vehicle may have an effect in the maximum interlinking between Y and Z. Such effect by a turning vehicle, however, is limited since if such vehicle actuates the detector y_1 in the main road red period ahead of the leading vehicle in the block of vehicles approaching from X the transmission of the interlinking impulse to relay 20R at Z will be delayed until the cross road amber period at Y, which is substantially at the end of the main period at Y. If the cross road traffic at Y holds the main red to a maximum the effect of the turning vehicle will be the same as if the leading vehicle in the regular block of traffic actuated detector y_1 . If, however, the main red at Y terminated before its maximum then the turning vehicle would to that extent start the displacement period at Z sooner and the subsequent maximum main green at Z would occur sooner. Generally with such shorter main road red period at intersection Y the main red period at the other intersections will also be shorter due to generally lighter cross traffic so that such turning vehicles would not have much effect on the system as a continuing matter at an ordinary series of intersections.

It will be appreciated that in many instances in applying the maximum interlinking feature of the invention to expedite the movement of through traffic along the main road, the addition of the repeat pulsing feature will be of considerable advantage, since as described, this feature will provide that actuations of eastbound traffic at intersection X are also transmitted to intersection Y so as to present a demand for subsequent transfer of the green signal to the main road at Y if it has been on the cross road and will also tend to maintain the green signal on the main road at Y by resetting of the charge on condenser QA at Y if the green signal is already on the main road in the vehicle interval position of the Y controller.

It will be seen that this method of progressively co-ordinating a series of traffic-actuated controllers by providing a predetermined displacement period before commencing the maximum timing at each intersection enables heavy main road traffic to proceed without undue delay whilst at the same time sufficient time is allowed to enable cross traffic to filter through. There is no master controller to involve the possibility of interference during light traffic periods and furthermore in place of the arbitrary termination of right of way periods by a master controller during periods of heavy traffic the system described

provides a related sequence of commencement of maximum periods at successive intersections which is flexible in accordance with the varying traffic conditions.

Referring again to Fig. 1 it will be seen that when the switch J between terminals 10 and 11 is closed, relay M will be operated no matter which signal lamps are lit at the time of completion of phase displacement timing. A pulse will therefore be stored should the lamps not be showing green to the main road at the completion of displacement timing and this arrangement may bring the controller more quickly into a predetermined progressive plan than by the other arrangement where the displacement timer can only be effective during the main road green period. The two arrangements can be simply tried out in practice when their relative merits under the conditions of any particular main road can be readily observed.

Two phase displacement switches PD1 and PD2 are provided in each controller to cater for vehicles approaching from opposite directions and it will be understood that in the event of relays OR and PR being operated simultaneously by traffic which is being freed from the adjacent intersections, the time interval represented by the switch with the lowest resistance setting will become effective.

In order to prevent right of way being withheld from the cross roads during light traffic periods if for example a main road detector pad should become permanently operated and there are no other vehicles in the main road to give an interlinked maximum from an adjacent intersection, a long maximum charging circuit is provided by way of resistance BR and resting armature m_2 .

We claim:

1. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, a time-controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actuation of the traffic actuated means in such road, a maximum timer associated with said mechanism for limiting such prolongation of right of way on the main road at one intersection when initiated in operation, and means operated by actuation of the traffic actuated means in the main road at another intersection by traffic thereat approaching said one intersection to initiate operation of the maximum timer at said one intersection subsequently during accord of right of way to the main road at said one intersection.

2. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actuation of the traffic actuated means in such road, a maximum timer associated with said mechanism for limiting such prolongation of right of way on

the main road at one intersection when initiated in operation, and means operated by actuation of the traffic actuated means in the main road at another intersection by traffic thereat approaching said one intersection to initiate operation of the maximum timer at said one intersection at the end of a time period after such last named actuation, which period is substantially equivalent to the expected time of travel of traffic from said other intersection to said one intersection.

3. In a traffic control system for a plurality of intersections of cross roads with a main road having a traffic actuated right of way signal mechanism at each of the intersections each mechanism adapted to accord right of way alternately to the main and cross roads at the intersections in response to actuation by traffic in the respective roads and including minimum and maximum time limiting devices to maintain right of way so accorded to the respective roads for a minimum period and up to a maximum period, the latter in case of a plurality of successive traffic actuations; means actuated by the first unit of traffic approaching one of the intersections along the main road in passing another of said intersections while right of way is accorded to the main road at said another intersection, and means associated with the mechanism at said one intersection to measure a time period beginning with and in response to such actuation of the last named traffic actuated means and of predetermined length substantially equivalent to the time required for such actuating traffic to travel between said intersections and operating at the end of such travel time period to reset the maximum time device at the latter intersection on the main road if right of way is accorded to the main road, to measure a maximum time limit from such end of such travel time period whereby traffic proceeding along the main road from said another intersection to said latter intersection may be given a maximum right of way period at said latter intersection starting substantially with the arrival of the first unit of traffic at said latter intersection.

4. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection and adapted when effective to be initiated into operation by an actuation of the cross road traffic actuated means while right of way is on the main road to provide a limit to such prolongation of right of way on the main road, a further timing means initiated into operation substantially when right of way is first accorded to the main road at an adjacent intersection and in response to actuation of the traffic actuated means in the main road thereat by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road starting through said adjacent intersection toward said one intersection to reach said one

intersection, and means operated by said timing means at the end of the last-named period to render said maximum timer effective to be so initiated by cross road traffic actuation.

5. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection and having a long time period for limiting such prolongation of right of way on the main road, further timing means initiated into operation substantially when right of way is first accorded to the main road at an adjacent intersection and in response to actuation of the traffic actuated means in the main road thereat by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road starting through said adjacent intersection toward said one intersection to reach said one intersection, means operated by said timing means at the end of the last named period while right of way is being accorded to the main road at said one intersection to reset said maximum timer to restart it for timing a shorter maximum period.

6. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection for limiting such prolongation of right of way on the main road, means operated by said mechanism at another intersection upon transfer of right of way thereat to the main road in response to actuation of the traffic actuated means in the main road by traffic approaching said one intersection to cause subsequent initiation of timing by the maximum timer at said one intersection.

7. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection and having a long time period for limiting such prolongation of right of way on the main

road and initiated into operation by actuation of the cross road traffic actuated means while right of way is accorded to said main road, timing means at said one intersection, initiated into operation substantially when right of way is first accorded to the main road at an adjacent intersection and in response to actuation of the traffic actuated means in the main road thereat by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road starting through said adjacent intersection toward said one intersection to reach said one intersection, means operated by said timing means at the end of the last-named period while right of way is being accorded to the main road at said one intersection if the maximum timer thereat has been so initiated into operation to reset said maximum timer to restart it for timing a shorter maximum period.

3. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads for a time period in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection and having a long time period for limiting such prolongation of right of way on the main road and initiated into operation by actuation of the cross road traffic actuated means while right of way is accorded to said main road, timing means, initiated into operation substantially when right of way is first accorded to the main road at an adjacent intersection and in response to actuation of the traffic actuated means in the main road thereat by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road starting through said adjacent intersection toward said one intersection to reach said one intersection, means operated at the end of the last-named period while right of way is being accorded to the cross road at said one intersection to reduce the time period of said maximum timer to a value considerably less than said long time period when said maximum timer next operates during following accord of right of way to the main road, said last named means comprising relay means connected to be initially energized by said timing means at the end of its timing period, a locking device for said relay means to maintain it energized after such initial energization a control connection between said locking device and said mechanism at said one intersection to release said locking device only momentarily at the end of the main road right of way period, and a timing control circuit means for said timing means connected with said relay means to be operated by energization of the latter to reduce the timing period of said timing means.

9. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signal-

ling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection for limiting such prolongation of right of way on the main road and initiated into operation by actuation of the cross road traffic actuated means while right of way is accorded to said main road, timing means, initiated into operation substantially when right of way is first accorded to the main road at an adjacent intersection and in response to actuation of the traffic actuated means in the main road thereat by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road starting through said adjacent intersection toward said one intersection to reach said one intersection, means operated at the end of the period of the last-named means if right of way is being accorded to the main road and said maximum timer has been so initiated at said one intersection to reset said maximum timer substantially to zero whereby a group of vehicles released at said adjacent intersection are ensured right of way at said one intersection without interruption by said maximum timer.

10. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way to one of the roads in response to actuation of a traffic actuated means occurring therein while right of way is not accorded in such road and to prolong right of way by actuation of the traffic actuated means occurring while right of way is accorded to said one road; a maximum timer associated with said mechanism at one intersection and having a condenser, means including resistance for charging said condenser at a slow rate when connected to said condenser, means responsive to a predetermined value of charge on said condenser to cause transfer of right of way from the main road to the cross road, means operated while right of way is on the main road upon actuation of the traffic actuated means in the cross road to connect said charging means to said condenser, further timing means, initiated into operation when the signalling means at an adjacent intersection transfers right of way to the main road in response to actuation of the traffic actuated means in the main road by traffic approaching said one intersection, for timing a period of predetermined length which is substantially the time required for a vehicle on the main road to travel from said adjacent intersection to said one intersection, and means operated at the end of the period of said last-named means to discharge the condenser of the maximum timer momentarily in order to prolong the maximum time period of right of way on said main road.

11. In a traffic control system for a plurality of intersections of cross traffic lanes with a common main lane having at each intersection traffic actuated means in the lanes, traffic signal control mechanism for displaying "go" and "stop" signals alternately to each lane in a cycle for time periods in accordance with actuation of the

traffic actuated means in the respective lanes, means including a timer at one intersection and operating when effective to limit the "go" signal period on the main lane thereat within a maximum time period, a first relay operated by actuation of the traffic actuated means in the main lane at another intersection, a second relay operated in each cycle by said mechanism at said other intersection during the time period said "stop" signal is accorded to said main lane and a third relay operated by said mechanism at said other intersection for a portion of said "stop" signal period just prior to display of the "go" signal, a stick circuit for said first relay including a make contact of said second relay, an impulsing circuit to the control mechanism at said one intersection and including a make contact on said first relay and make contacts on said second and third relays in series whereby operation of said first relay during said portion of the "stop" signal period completes said impulsing circuit immediately to said control mechanism at said one intersection and operation of said first relay during any other portion of the cycle prepares said circuit for completion only by said second and third relays when said portion of the "stop" signal period is reached, and means responsive to completion of said impulse circuit to render said timing means so effective to limit the next subsequent "go" signal period on the main lane at said one intersection.

12. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actuation of the traffic actuated means in such road, a maximum timer associated with said mechanism for limiting such prolongation of right of way on the main road at one intersection when operating, a time controlled switch means having switch means operated at the end of a time interval from energization, contact means operated by actuation of the traffic actuated means in the main road at another intersection by traffic approaching said one intersection, means including said contact means to energize said time controlled switch means, contact means operated by the said mechanism of said one intersection during accord of right of way to the main road thereat, contact means operated by the traffic actuated means in the cross road at the latter intersection and circuit means connecting the two last named contact means and said switch means to so operate said maximum timer responsive to said two last contact means and said switch means being operated..

13. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actuation of the traffic actuated means in such road, a maxi-

imum timer associated with said mechanism for limiting such prolongation of right of way on the main road at one intersection when operating, a time controlled switch means having switch means operated at the end of a time interval from energization, contact means operated by actuation of the traffic actuated means in the main road at another intersection by traffic approaching said one intersection, a second contact means operated by the said mechanism of said other intersection substantially upon transfer of right of way from the cross road to the main road thereat, means including the first and second contact means to energize said time controlled switch means, contact means operated by the said mechanism of said one intersection during accord of right of way to the main road thereat, contact means operated by the traffic actuated means in the cross road at the latter intersection and circuit means connecting the two last named contact means and said switch means to so operate said maximum timer responsive to said two last contact means and said switch means being operated.

14. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time-controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actuation of the traffic actuated means in such road, a maximum timer associated with said mechanism for limiting such prolongation of right of way on the main road at one intersection when operating, a time controlled switch means having switch means operated at the end of a time interval from energization, contact means operated by actuation of the traffic actuated means in the main road at another intersection by traffic approaching said one intersection, a second contact means operated by the said mechanism of said other intersection substantially upon transfer of right of way from the cross road to the main road thereat, means including the first and second contact means to energize said time controlled switch means, contact means operated by the said mechanism of said one intersection during accord of right of way to the main road thereat, contact means operated by the traffic actuated means in the cross road at the latter intersection and circuit means connecting the two last named contact means and said switch means to so operate said maximum timer, responsive to said two last contact means and said switch means being operated, and said time controlled switch means having its time interval adjusted to be substantially equivalent to the expected time of travel of traffic from said other intersection to said one intersection.

15. In a traffic control system for a plurality of intersections of cross roads with a common main road having at each intersection right of way signalling means for the main and cross roads, traffic actuated means in each road, and time controlled mechanism for operating said signalling means to transfer accord of right of way alternately to the roads in response to actuation of the traffic actuated means in the respective roads and to prolong right of way in a road where it is being accorded upon further actu-

ation of the traffic actuated means in such road,
a maximum timer associated with said mechanism
for limiting such prolongation of right of
way on the main road at one intersection when
operating, a time controlled switch means having
switch means operated at the end of a time interval
from energization, contact means operated
by actuation of the traffic actuated means in the
main road at another intersection by traffic approaching
said one intersection, a second contact means
operated by the said mechanism of said other
intersection substantially upon transfer of right
of way from the cross road to the main road
thereat, means including the first and second
contact means to energize said time controlled
switch means, contact means operated by the
said mechanism of said one intersection during
accord of right of way to the main road thereat,
contact means operated by the traffic actuated
means in the cross road at the latter intersection
and circuit means connecting the two last named
contact means and said switch means to so operate
said maximum timer, re-

sponsive to said two last contact means and said
switch means being operated, said switch means
comprising a switch operated momentarily at the
end of the time interval of said time controlled
switch means, a relay, an energizing circuit for
said relay including the last named switch and
further contact means closed by said mechanism
during accord of right of way to the main road
at said one intersection, a stick circuit for said
relay including a contact means opened by said
mechanism only momentarily at the end of the
last mentioned accord of right of way, a switch
included in said maximum circuit means and
operated by said relay when energized to prepare
said circuit means to operate said maximum
timer responsive to operation of the two contact
means connected to said circuit means, and a
switch connected to said further contact means
and manually operable for shunting said further
contact means.

GEORGE WILLIAM THOMPSON.
ALFRED PERCY BAILEY RENSHAW.