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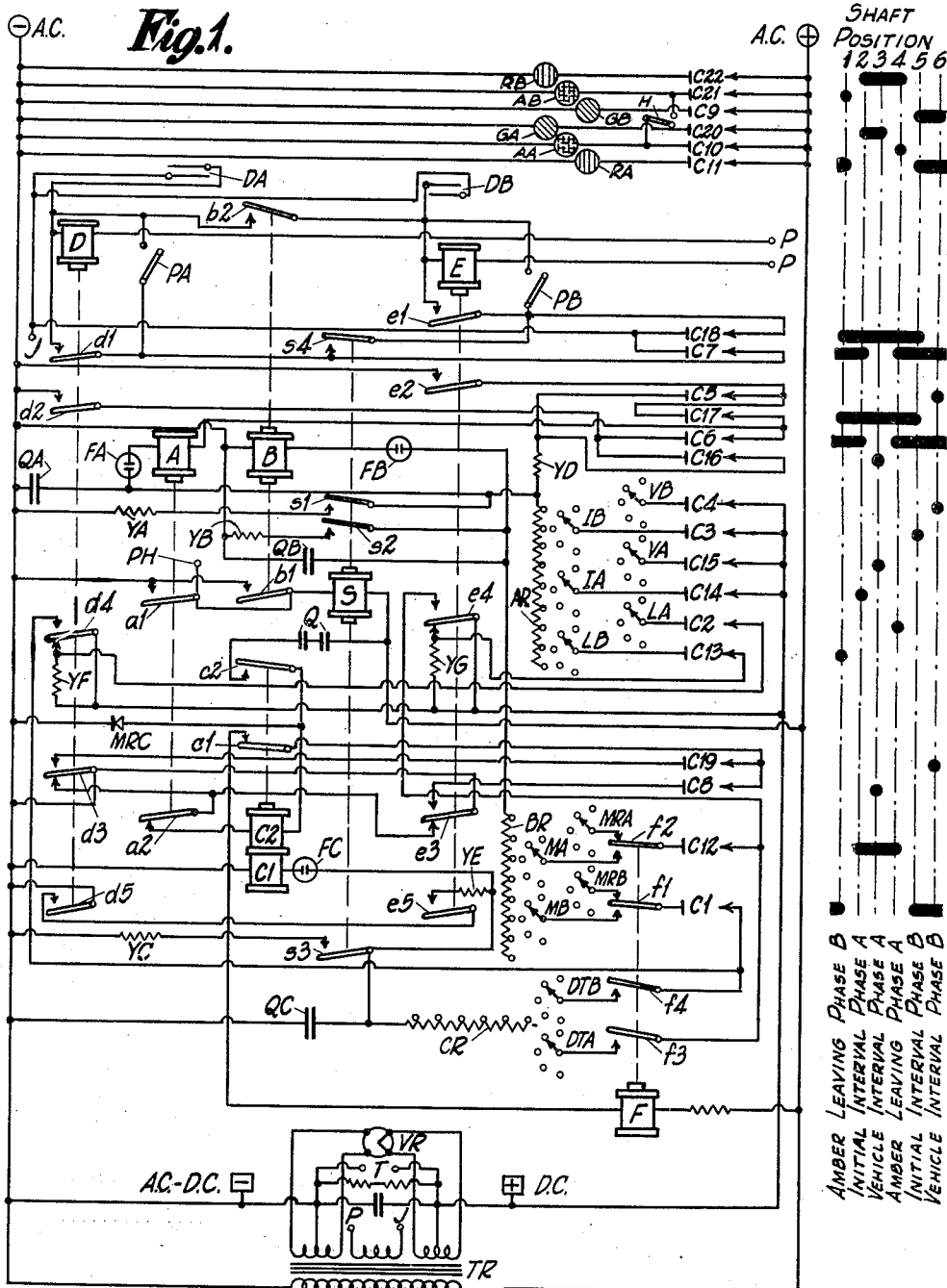
A. P. B. RENSHAW ET AL

2,135,472

TRAFFIC CONTROL SYSTEM

Filed May 16, 1936

3 Sheets-Sheet 1



AMBER LEAVING PHASE B
INITIAL INTERNAL PHASE A
VEHICLE LEAVING PHASE A
AMBER LEAVING PHASE B
INITIAL INTERNAL PHASE B
VEHICLE LEAVING PHASE B

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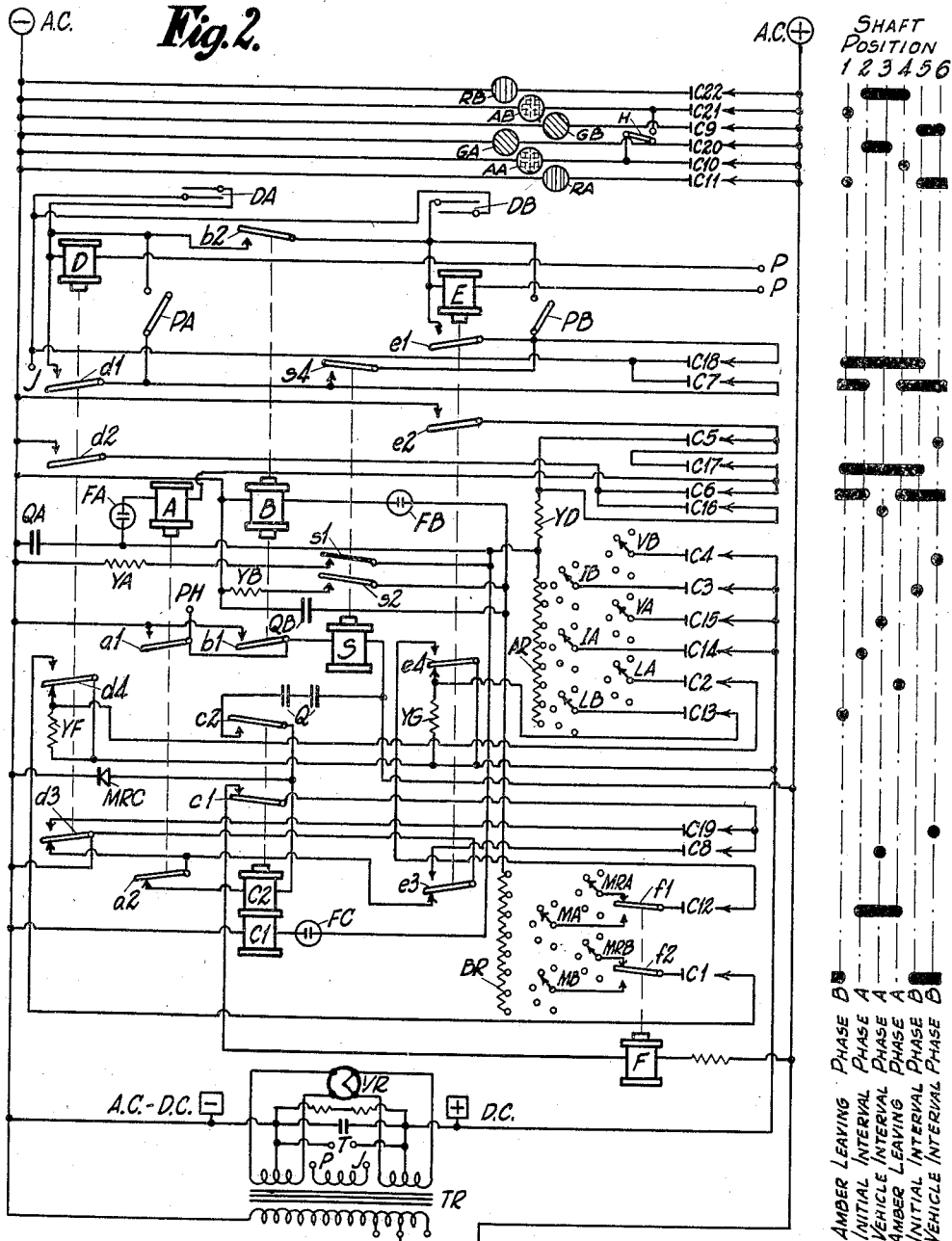
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3 Sheets-Sheet 2



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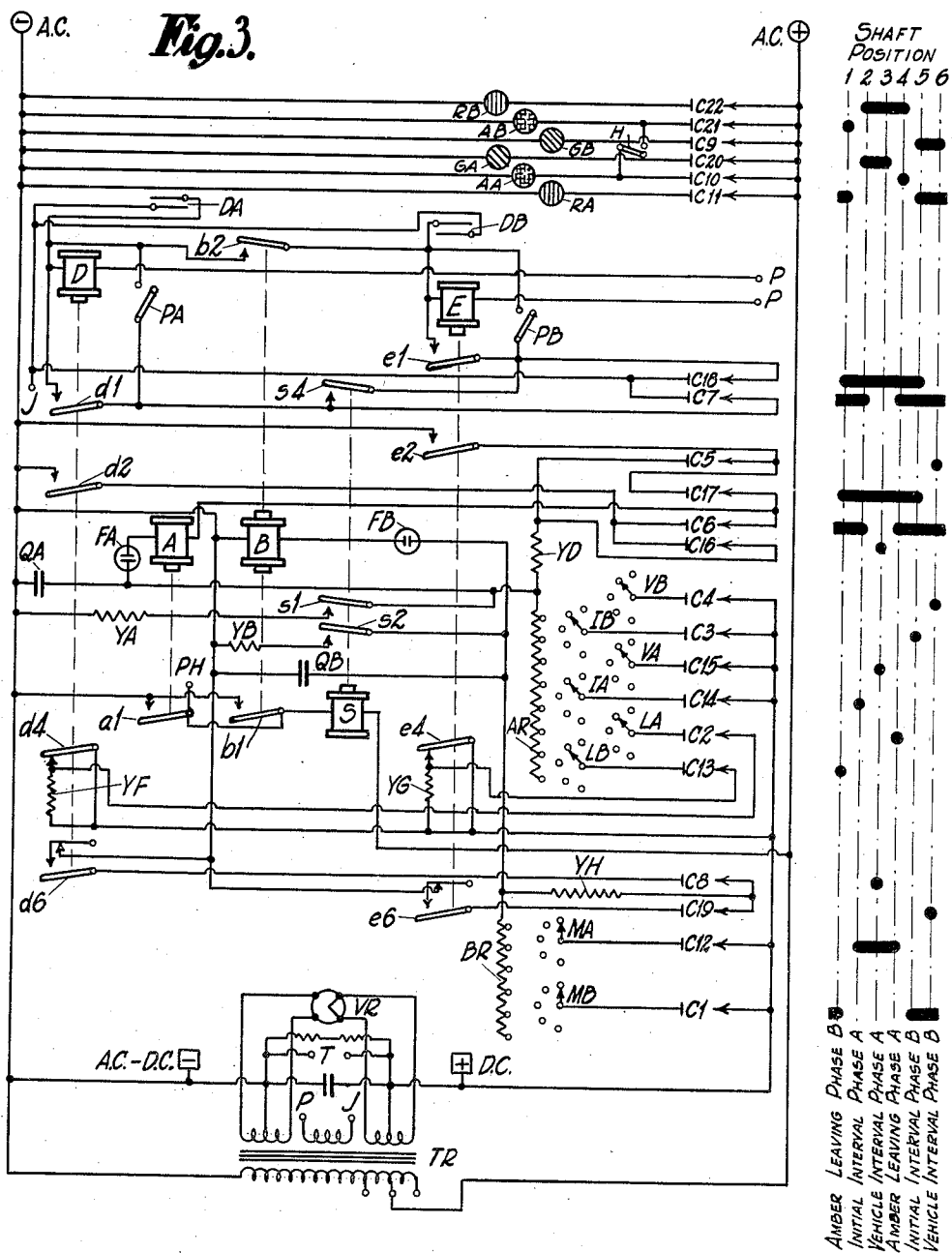
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TRAFFIC CONTROL SYSTEM

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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,135,472

TRAFFIC CONTROL SYSTEM

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Application May 16, 1936, Serial No. 80,056
In Great Britain May 21, 1935

11 Claims. (Cl. 177—337)

The present invention relates to traffic control signals for use at road junctions or the like and is more particularly concerned with systems in which the period of display of the appropriate signals is controlled by traffic detectors located in one or more of the various traffic lanes. In one well-known system of this type it is arranged that when a vehicle actuates a detector, it secures to itself right of way for a period sufficient to enable it to clear the crossing and accordingly if vehicles follow each other sufficiently closely right of way may be repeatedly extended. However, in order that vehicles on an intersecting road shall not be unduly held up, separate maximum timing means are provided to set a limit to the time during which one road can hold right of way if traffic is waiting on an intersecting road.

Traffic control systems operating on this principle give good results in practice but a difficulty sometimes arises in that owing to irregularities in traffic flow right of way may be lost during comparatively small gaps in an otherwise continuous stream of traffic unless the vehicle extension period is sensibly increased. If this is done however, it means that each vehicle generates an extension period in excess of its actual individual requirements and accordingly the time right of way is held by any particular road cannot be strictly proportioned to the density of the traffic flow thereon. This limitation is of little consequence in circumstances where the traffic densities on the respective roads are substantially constant because the required distribution of right of way can be secured independently by a suitable setting of the maximum timing switches, but in cases where there is an appreciable variation in the traffic density, better distribution than can be obtained by this method is desirable. The chief object of the invention is to provide a simple arrangement whereby an improvement in this sense may be realized in practice without any appreciable complication of the usual controlling equipment.

According to the invention, in a traffic control system arranged to maintain right of way to a traffic lane as long as detector operations occur therein at intervals of less than a predetermined value but subject to a maximum period if traffic on an intersecting lane is requiring right of way, the maximum period for a traffic lane is arranged to be variable in accordance with the density of traffic in that lane.

The invention will be described and explained

in connection with the accompanying sheets of drawings in which:

Figure 1 is a circuit diagram for one form of a traffic control system embodying the invention and comprising signal lights, signal controller or timer, and traffic actuatable detectors.

Figures 2 and 3 are each diagrams for alternative forms of the system of Figure 1 in which fewer parts are required in the signal controller but the facilities for the adjustment of timed intervals are not as complete as in the arrangement of Figure 1.

Referring now to Figure 1, there is illustrated a controller of the type now well known suitable for a straight forward right-angled crossing 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 arrangement shown makes use of the well known 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 road in which right of way is being interrupted, this second timing circuit sets a maximum value to the period which a vehicle thereon will have to wait. In the arrangement illustrated in Figure 1 the improved working according to the invention is attained by the provision of a third timing circuit which controls the operation of the second timing circuit by varying the resistance connected in the charging circuit of the condenser of the second timing circuit.

Considering now the detailed operation of the circuits shown in Figure 1 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 line 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 in a square, suitable smoothing devices being employed. From the terminals P and J of the middle secondary winding alternating current of a suitable low voltage is obtainable for use in the detector circuits. Normally one side of the line, as the minus side, will be connected to ground. The terminals marked T are provided for convenience in testing.

The table at the right side of Figure 1 shows by a black circle or bar the shaft positions in which the various cam contacts are closed. It will later be apparent from the description 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 A or phase B.

For the purpose of description it will be assumed that the shaft is standing in position 3 giving right of way to phase A. Traffic now arriving on this road will operate the detector DA and hence, through the circuit from terminal P via relay D and detector DA to terminal J, will operate the relay D intermittently and this relay at armature d2 will shunt the condenser QA by resistance YD each time the relay is operated since cam contacts C16 are closed. The charging circuit for this condenser is completed from positive over cam contacts C15 and the phase A vehicle interval adjusting switch VA which is suitably wired to theappings of the common resistance AR and charging of condenser QA proceeds between actuations of relay D by vehicles on phase A. If a vehicle now appears on phase B it will operate detector DB and energize relay E which locks up at armature e1. Moreover at armature e3 a circuit is completed over cam contacts C8 and armature c1 for relay F which is accordingly operated. Also the neon tube FA and relay A are connected by way of armature e2 and contacts C17 across the condenser QA so that if the potential of the condenser rises sufficiently to reach the striking voltage of FA then relay A is operated by discharge of the condenser through this tube and relay. Assuming for the moment that the condenser potential has not risen to the striking voltage, then also by relay E at armature e4 a charging circuit is completed by way of cam contacts C12, operated armature f2, the maximum adjusting switch MA and the common resistance BR for the condenser QB, and also a branch charging circuit is supplied through armature e4 over armature f3 and the density timing adjusting switch DTA and common resistance CR for condenser QC. In consequence of the operation of armature e5, each time that relay D is operated by further traffic on phase A, condenser QC is shunted at armature d5 over resistance YE. The adjustment of the various switches is such however that condenser QC will attain the striking voltage of the tube FC before condenser QA will attain the striking voltage of the tube FA.

Accordingly, if the traffic is heavy on phase A so that both condensers QA and QC are maintained substantially discharged, relay F remains energized and the maximum period, i. e. the time required to charge condenser QB to the striking voltage of the lamp FB, is determined by the setting of the maximum adjusting switch MA. If, however, the density of traffic on phase A falls off so that condenser QC is enabled to reach

the striking voltage of tube FC, relay C is operated by winding C1 and at armature c1 opens the circuit of relay F and at armature c2 completes a locking circuit for itself by way of condensers Q, its winding C2, armature d2 and armature d3. The rectifier MRC is provided in order to give reliable operation of relay C which is of the direct current type. In view of the release of relay F the charging resistance in the maximum timing circuit is now connected up over the back contact of armature f2 and the reduced maximum adjusting switch MRA which is wired to the same resistance BR but is set to give a more rapid charging effect. Moreover at armature f3 the charging circuit for the density timing circuit is opened. If further traffic arrives on phase A before the operation of either relay A or relay B, relay D is again energized and at armature d3 opens the locking circuit of relay C which therefore de-energizes and again connects up relay F whereupon the conditions previously described are restored.

Assuming that there is eventually a gap in the phase A traffic sufficient to enable condenser QA to charge up to the striking voltage of tube FA thus causing relay A to operate, relay A at armature a1 then completes the circuit of the solenoid S and at armature a2 opens the locking circuit of relay C which will necessarily be energized at the time. The solenoid now advances the cam shaft into position 4 and at its contacts s1, s2 and s3 shunts condensers QA, QB and QC by resistances YA, YB, and YC respectively, so as to ensure that they shall start the next timing period with substantially no residual charge. In position 4 cam contacts C2 are closed and the charging circuit for condenser QA therefore extends over the amber adjusting switch LA. If the stepping of the cam shaft had been brought about by relay B due to the striking of maximum circuit neon tube FB, armature b2 and solenoid contacts S4 would be operated to ensure that relay D still remained energized over its clocking circuit via d1 and C1 for retransferring right of way to the A phase at the earliest opportunity, and consequently the charging circuit would now include resistance YF which gives an extended amber period to give time for the crossing to clear. The continued energization of relay D ensures that right of way shall return to phase A without any further detector operation so as to release any vehicles which may have been stopped. If relay D is not operated however resistance YF is short-circuited by contact d4 and the amber period is correspondingly shortened. It will be appreciated that some degree of extension is obtained if the detector DA is crossed by a vehicle during the amber period.

When condenser QA has reached the striking voltage of tube FA, the tube flashes and relay A in series with the tube is energized momentarily. Relay A at contact a1 causes solenoid S to operate and advances the cam shaft to position 5.

When the cam shaft is in position 5, charging takes place over cam contacts C3 and the initial interval adjusting switch IB 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 operation of either of the detectors. The cam shaft is now in the vehicle interval position for phase B and conditions are similar to those described for phase A and no detailed description is therefore necessary as the circuits are symmetrical as between the two phases.

It will be understood that the signalling lamps GB, AA, RA, GA, AB, and RB 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 at the right of Fig. 1. When the switch H is closed a connection is established between the amber lamps AA and AB to give an amber indication with the red indication immediately prior to the change to green as well as following the green.

The switches PA and PB associated with the detector circuits are so-called arterial switches and the throwing of a switch 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 terminal PH may be connected to a push button to enable stepping of the solenoid to be effected manually.

It may be mentioned that with the circuit as shown in Figure 1, traffic on the phase possessing right of way will exert some additional control on the density timing circuit over the opposite density timing switch. This effect however, only occurs during actual detector operation and is not found to produce any objectionable effect since resistance YE is low enough to discharge condenser QC substantially completely each time relays D and E are operated together.

The signal control system of Figure 2 is generally similar to that shown in Figure 1 in function and construction but has the following differences. Condenser QC, together with its charging circuit over contacts f3 and f4, switches DTA and DTB, resistance CR, are omitted from Figure 2, and the neon tube FC and winding C1 of its cooperating relay C are now connected directly across condenser QA. It is necessary in this case for the tube FC to strike at an appreciably lower voltage than the tube FA. With this circuit arrangement the discharge circuits thru resistor YC and contact s3 and thru resistor YE and contacts d5 and e5 may also be omitted. The arrangement shown in Figure 2, however, does not give such complete facilities for adjustment as that of Figure 1.

The arrangement of the system in Fig. 2 operates through its cycle in the same general manner as that of Fig. 1, condenser QA being charged over the resistance AR and the appropriate adjusting switch and cam contact in each of the several positions of the camshaft, and upon the potential on condenser QA reaching the striking voltage of tube FA, the condenser discharges through tube FA to operate relay A, and in turn the solenoid S, to step the camshaft to the next position, all as described in connection with Fig. 1. As in Fig. 1, in positions 3 and 6 of the shaft, vehicles arriving on the phase having the right of way will momentarily discharge condenser QA and thus delay it in reaching the striking voltage of tube FA and so prolong the time the shaft remains in such position and the time of right of way on such phase. This prolongation is limited by the maximum timing unit including condenser QB, the associated charging circuits over resistance BR and appropriate maximum time adjusting switch and cam contact, and the tube FB and relay B which are operated where condenser QB is charged to the striking potential of tube FB to operate solenoid S, as described in connection with Fig. 1.

Further in Fig. 1 the charging time of the maximum timing condenser QB is reduced by de-energizing relay F through energization of relay C, but the means for energizing relay C is somewhat different. In Fig. 2, tube FC and relay coil C1, as well as tube FA and relay A, are connected across condenser QA. Assuming the camshaft to be in position 3 for example, the condenser QA will be charged gradually between actuations of relay D by vehicles on phase A, and if a vehicle is waiting on phase B relay E will be maintained operated and relay F will be energized. Tube FC has a considerably lower striking voltage than tube FA and as condenser QA is charged, if the time is sufficient between vehicle actuations on phase A, the striking potential of tube FC will be reached first, the tube will ignite and sufficient current will flow from condenser QA through relay coil C1 to energize the relay, and the relay will lock up over its second coil C2 and associated contact c2 as in Fig. 1. The impedance of the circuit through relay coil C1 is sufficient in relation to the charging resistance AR, with appropriate capacity of condenser QA, so that condenser QA can continue to charge to the striking voltage of tube FA if sufficient further time elapses before another vehicle actuation on phase A. When relay C is energized relay F is de-energized as in Fig. 1, and if another A phase vehicle actuation occurs, energizing relay D, then relay C will be de-energized and relay F re-energized as in Fig. 1. It will thus be observed that Fig. 2 differs from Fig. 1 only in the arrangement for energizing relay C.

A further alternative arrangement which does not involve the use of a third neon tube, is shown in Figure 3. Herein the maximum timing condenser QB is arranged to be partially discharged by traffic in the road possessing right of way. Accordingly an actuation of detector DA while right of way is on the A phase with the controller in position 3, would by its momentary operation of relay D cause condenser QB to be partially discharged over contacts d6, cam contacts C8, closed in shaft position 3, and resistor YH. Similarly in the B phase vehicle interval position 6, actuations of detector DB cause QB to be discharged over contacts e6. In this arrangement the resistance BR in the maximum period charging circuit is set at a comparatively low value while the discharge resistance YH is sufficiently high so that it cannot prevent the striking of the tube FB if a detector were operated continuously. Thus the partial discharging of the condenser through resistor YH does not reduce the charge on the condenser but reduces the rate of charging, by shunting off a part of the current flowing through charging resistance BR. This embodiment of the controller eliminates tube FC, relays C and F, contacts c3, d3 and adjusting switches MRA, MRB of the Figure 2 device.

If desired the make-before-break type of contacts e6, d6, in Figure 3 may be replaced by ordinary make type contacts when used in conjunction with cam contacts C8 and C19, or if the make-break contacts are retained, cam contacts C8 and C19 may be omitted. In the latter case, where the make-break type contacts are used, the period of contact closure is independent of the length of time the detector is operated, and accordingly satisfactory operation may be obtained without cam contacts C8 and C19, allowing the shunting of the condenser QB to be pro-

duced at any time by operation of either of the road relays.

The invention therefore by means of a simple addition to a system of known type and proved reliability provides a refinement which makes the system more efficient in avoiding congestion and facilitating the free flow of traffic with the minimum of delay.

While in the foregoing description several modifications of the invention and their method of application to a form of traffic control system have been illustrated it will be apparent to those skilled in the art that the invention may take many forms, and it is not to be construed that the invention is limited to these particular embodiments. Further it will be appreciated that numerous changes in construction or rearrangement of the parts might be made without departing from the spirit of the invention as defined in the claims.

We claim:

1. A traffic control system arranged to control right of way in a traffic lane and including in combination, traffic actuated means in the lane, a control mechanism for according right of way to and transferring right of way from said lane, said mechanism including timing means for maintaining right of way in said lane for at least a minimum and up to a maximum period in response to successive operations of said traffic actuated means occurring during accord of right of way to said lane, and spaced from each other within a predetermined time interval, a timing device included in said control mechanism to measure a time interval less than said predetermined time interval and beginning from each of such operations of the traffic actuated means, and means operating upon completion of its time interval by said timing device to reduce said maximum period of said timing means.

2. A traffic control system for the control of right of way on intersecting traffic lanes including in combination, traffic actuated means in one of said lanes, a control mechanism for according right of way to and transferring right of way between said lanes, said mechanism including three timing devices for controlling the time of accord and transfer of right of way by said mechanism, one of said timing devices for timing the intervals between successive operations of the traffic actuated means by traffic in said one lane occurring while right of way is accorded to said one lane and for initiating transfer of right of way to another of said lanes by said control mechanism in response to operation of the traffic actuated means in said another lane and only if such intervals between successive operations exceeds a predetermined value, and a second of said devices to provide a maximum time limit to right of way in said one lane and to initiate transfer of right of way to said another lane if right of way is accorded in said one lane up to such limit, and the third of such devices to time a certain time interval of less than said predetermined value and beginning from each of said successive operations of said traffic actuated means in said one lane and to reduce said time limit of said second device if the time interval between such successive operations exceeds said certain time interval.

3. A traffic control system for control of right of way at intersecting traffic lanes including in combination a traffic actuated means in one of said lanes, a control mechanism for according right of way to and transferring right of way

between said lanes, said mechanism including three timing devices for controlling the time of accord and transfer of right of way by said mechanism, at least the first and third of which devices each comprise a condenser, means for varying the charge on the condenser from an initial value to a final value and means operating responsive to the final value of charge on said condenser to indicate the completion of the time interval of the time device, one of said devices adapted to operate while right of way is accorded to said one lane to control the time of right of way in said one lane and including means connected between said traffic actuated means and said condenser to reset the charge on said condenser substantially to said initial value by each operation of said traffic actuated means to maintain right of way in said lane for a longer time and also including means to initiate transfer of right of way to another lane if said charge responsive means so operates at the completion of its time interval, a second of said devices adapted to operate while right of way is accorded to said one lane to provide a maximum time limit beyond which right of way cannot be maintained in said lane by successive reset of the first timing device by traffic and including means to initiate transfer of right of way to said another lane if right of way is maintained up to such limit, and the third timing device adapted to operate while right of way is accorded to said one lane and also including means for resetting the charge on its condenser substantially to said initial value in response to each such operation of said traffic actuated means so as to time a certain interval beginning from each such operation, and means operated by operation of the charge responsive means of said third timing device to reduce the time limit of said second timing device.

4. A traffic control system as claimed in claim 3 in which one condenser is common to the first and third timing devices and in which the charge responsive means of said first and third timing devices are responsive to different values of charge on said common condenser.

5. A traffic control system as claimed in claim 3 in which the maximum limit is provided by a timer comprised of a condenser and means including a resistance for varying the charge on said condenser from an initial to a final value and means operating responsive to said final value of charge on said condenser to indicate the completion of the maximum time limit and in which the means for varying the maximum period includes means for varying said resistance.

6. A traffic control system to control right of way in a traffic lane and including in combination, traffic actuated means in said lane, a control mechanism for according right of way to and transferring right of way from said lane, said mechanism including a timing device for maintaining right of way in said lane in response to successive operations in said traffic actuated means occurring during accord of right of way to said lane, and spaced from each other within a predetermined time interval, a second timing device to provide a maximum time limit to right of way in said lane and to initiate transfer of right of way from said lane if right of way is accorded to said lane up to such limit, said second timing device comprising a condenser and means including a resistance for varying the charge on said condenser from an initial to a final value and means operating responsive to

said final value of charge on said condenser to complete said maximum time limit and initiate such transfer of right of way, and means in said control mechanism and operated by said traffic actuated means to partially counteract, by each operation of the traffic actuated means, the varying of the charge on said condenser toward said final value whereby frequent operations of said traffic actuated means will prolong said maximum period.

7. A traffic control system for the intersection of interfering traffic lanes and including in combination traffic actuated means in each of said lanes, means for according and maintaining right of way in one of said lanes as long as the traffic actuated means in said one lane is actuated by traffic successively at time intervals of less than a predetermined value, means operable upon an intervening actuation of the traffic actuated means in a second of said lanes to prevent such maintaining of right of way to said one lane beyond a maximum period beginning from the time of said second lane actuation, and means for decreasing said maximum period in response to the time spacing between successive actuations of the traffic actuated means in the said one lane exceeding a time period of shorter predetermined value than said first mentioned predetermined value but not exceeding the said mentioned predetermined value.

8. A traffic control system as in claim 7 and including means for increasing said maximum period again by another successive traffic actuation occurring at a time interval of more than said shorter value but less than said first mentioned predetermined value from the last previous actuation.

9. A traffic control system for the intersection of interfering traffic lanes and including in combination, traffic actuated means in each of said lanes, control means for according right of way to and transferring right of way between said lanes, said control means including a timing device for maintaining right of way in one of said lanes in response to operations of the traffic actuated means in said one lane during accord of right of way to said one lane and spaced from each other within a predetermined time interval, other means forming a part of said control means and started in operation by an actuation of the traffic intervening actuated means in a second of said lanes to prevent such maintaining of right of way to said one lane beyond a maximum period from the time of said second lane actuation, another timing device included in said control means to measure a time interval less than said predetermined time interval beginning from each of said successive operations of the traffic actuated means in said one lane, and means operating upon completion of the time interval by said last named timing device to reduce said maximum period.

10. A traffic control system for the control of right of way at the intersection of interfering traffic lanes including in combination traffic ac-

tuated means in each of said lanes, a control mechanism for according right of way to and transferring right of way between said lanes, said mechanism including three timing devices, one of said timing devices adapted to maintain right of way and time the intervals between successive operations of the traffic actuated means in one lane by traffic therein while right of way is accorded to said one lane and to initiate transfer of right of way to a second lane only if such intervals exceed a predetermined value, a second of said devices started in operation by an intervening actuation of the traffic actuated means in said second lane to provide a maximum time limit to right of way in said one lane and to initiate transfer of right of way to said second lane if right of way is maintained in said one lane up to such limit, and the third of such devices adapted to time a certain time interval beginning from each of said successive operations of said traffic actuated means in said one lane and to reduce said time limit of said second device if the time interval between such successive operations exceeds said certain time interval but does not exceed said predetermined value.

11. A traffic control system for control of right of way at the intersection of interfering traffic lanes and including in combination, traffic actuated means in the lanes, a control mechanism for according right of way to and transferring right of way between said lanes, said mechanism including a timing device for timing the intervals between successive operations of traffic actuated means in one lane while right of way is accorded to said one lane and to initiate transfer of right of way to a second of said lanes by said mechanism only if such intervals exceed a predetermined value, a second timing device for providing a maximum time limit to right of way in said one lane and comprising a condenser, means including a resistance for varying the charge on said condenser from an initial value to a final value over a time period corresponding to such time limit, and means operating responsive to the charge on said condenser reaching said final value to complete said time limit and to initiate transfer of right of way to said second lane by said mechanism if right of way is accorded to said one lane until said condenser reaches said final value of charge, relay means energized during accord of right of way to said one lane and providing a certain value of such resistance in said charge varying means, said relay means operable when deenergized to provide a different value of such resistance for increasing the rate of varying of the charge by said charge varying means to decrease the maximum time limit, and a third timing device adapted to time a certain time interval beginning from each of said successive operations of said traffic actuated means in said one lane and to deenergize said relay means if the time interval between such successive actuations exceeds said certain time interval.

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CERTIFICATE OF CORRECTION.

Patent No. 2,135,472.

November 1, 1938.

ALFRED PERCY BAILEY RENSHAW, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 43, for "clocking" read locking; page 5, first column, line 51, claim 9, strike out the word "intervening" and insert the same before "actuation", line 50, same claim; 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 24th day of January, A. D. 1939.

Henry Van Arsdale

Acting Commissioner of Patents.

(Seal)