

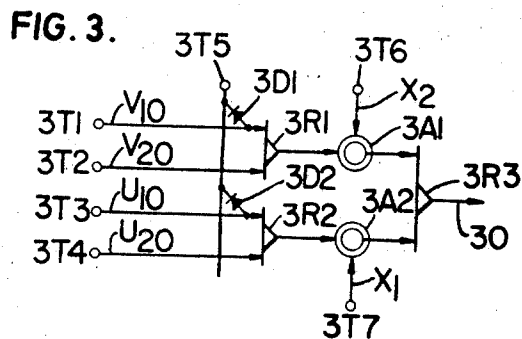
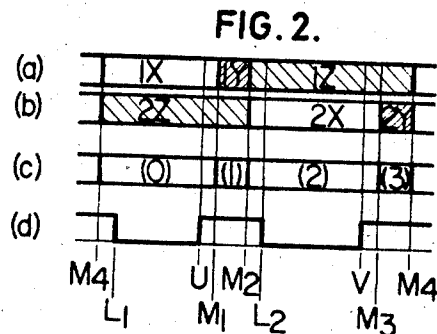
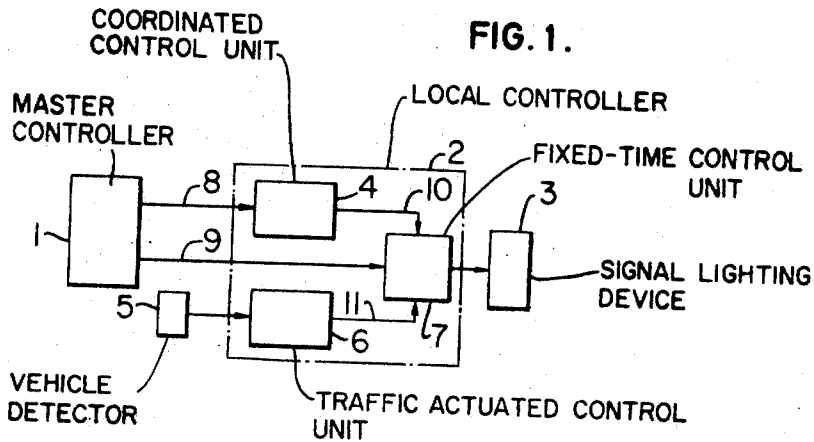
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HIROO WATANABE ET AL
LOCAL TRAFFIC SIGNAL CONTROLLER

3,500,309

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2 Sheets-Sheet 1

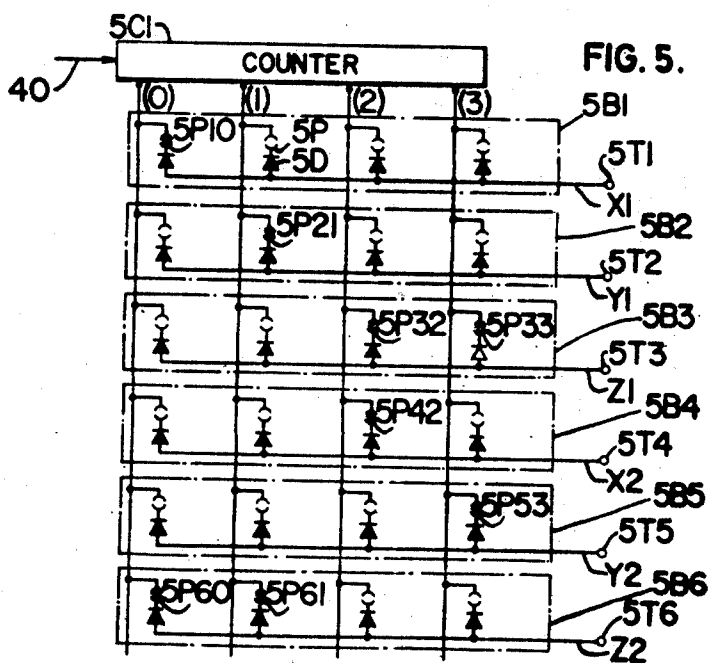
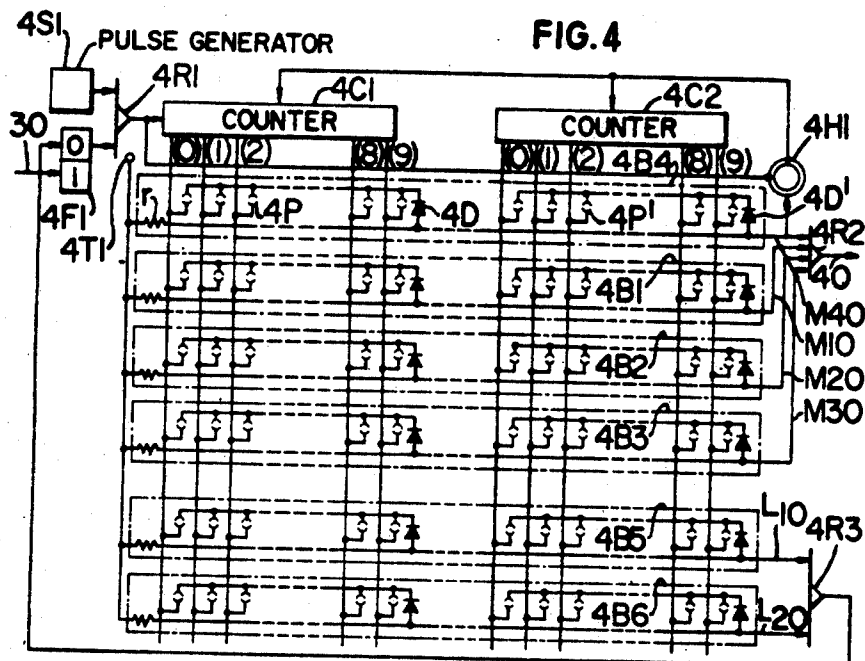


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LOCAL TRAFFIC SIGNAL CONTROLLER

2 Sheets-Sheet 2



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3,500,309

LOCAL TRAFFIC SIGNAL CONTROLLER

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7 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a traffic signal control system and more particularly to a local traffic signal controller adapted to be located at an individual street intersection. The system includes a fixed-time control unit for actuating traffic signals on a predetermined cycle basis; a traffic actuated control unit to cause the cycle time at a given intersection to be controlled by the traffic; and a coordinated control unit for controlling a number of intersections on a coordinated basis to facilitate through traffic movement. A simplified system using a memory device such as a bistable circuit for integrating the various operations to minimize the number of counters required in the system is disclosed. Overall system diagrams as well as specific circuit details are provided.

There are known several types of traffic signal control, such as a fixed-time control, traffic-actuated control, coordinated control and coordinated traffic-actuated control.

Local traffic signal controllers are designed to perform one of these types of control. It is advisable, however, to provide a local controller with various units corresponding to these types of control so that combination of two or more of these units can effect a desired type of traffic signal control.

Accordingly, it is one object of the invention to provide a traffic signal controller which can be operated to provide several types of traffic signal control.

Another object of the invention is to provide a traffic signal controller which is provided with a fixed-time control unit as a basic unit, a traffic-actuated control unit and a coordinated control unit as additional units, so that the latter two units are selectively connected to the basic unit to provide a desired type of traffic signal control. In accordance with the invention, when the basic unit only is used, fixed-time control is obtained; when the traffic-actuated control unit is connected to the basic unit, traffic-actuated control is obtained; and when both the coordinated and the traffic-actuated control units are connected to the basic unit, coordinated traffic-actuated control is obtained.

The three types of signal control will be defined as follows:

Fixed-time control.—That type of control in which a predetermined signal cycle is repeated, with preset time periods of green, amber and red indications.

Traffic-actuated control.—That type of control in which vehicle detectors detect traffic volumes on streets crossing at an intersection, so that the time period of green signal indication for the streets is automatically regulated.

Coordinated traffic-actuated control.—That type of control in which the green signal indication at each intersection in the system starts at a different time from that at the adjacent intersection so that a vehicle running at a predetermined speed on the main street can pass all the intersections in the system without stopping, and in which vehicle detectors detect traffic volumes on the main and cross streets so that the time period of green signal indication for the main street is shortened or extended, there-

by correlatively satisfying the need for traffic passage through the intersections on the main and cross streets.

The invention, with its above stated and other objects, features and advantages will be better understood from the following description of a preferred embodiment thereof with reference to the accompanying drawings wherein:

FIG. 1 is a schematic block diagram illustrating the master-local control system in accordance with the invention;

FIG. 2 is a time chart illustrating the signal indications in a two-phase system according to the invention; and

FIGS. 3 to 5 are diagrams which are combined to show the whole system of the invention.

Referring now in detail to the drawings, there is shown in FIG. 1 a master controller 1 adapted to control all the local controllers included in the system. Vehicle detectors (not shown) detect traffic volumes at different places in the system and send corresponding signals to the master controller, which in turn transmits through a line 8 a "split" selection signal, synchronizing signals and an "offset" selection signal to each local controller to control the signal indication at a signal lighting device 3. In FIG. 1, only one local controller is shown, but actually many local controllers are provided in the system, one at each intersection. The master controller also sends a control type selection signal to the local controller 2 through a line 9.

The local controller 2 comprises a coordinated control unit 4, a traffic-actuated control unit 6, and a fixed-time control unit 7. The coordinated control unit 4 is actuated by the signals coming through the line 8 to produce a green signal initiating signal on a line 10. The green indication initiating signal turns on the green signal light for the main street at each intersection a predetermined period of time delay, that is, "offset," after arrival of each of the synchronizing signals being sent through the line 8 in the same cycle as the signal cycle. The signal cycle is the time period between the beginning of a green signal indication and that of the next green signal indication. The offset is selected by an offset selection signal from the master controller, and the time difference in the commencement of green signal indication between adjacent intersections is determined by the selected offset.

The coordinated control unit 4 is designed to produce on the line 10 the green signal initiating signal for the main street and then the mainstreet green signal terminating signal after a predetermined time period, that is, "split," as selected by the "split" selection signal from the master controller.

The traffic-actuated control unit 6 is designed to receive signals from vehicle detectors 5 which are provided to detect traffic volumes on the streets. The unit 6 is so arranged that the maximum and minimum periods of green signal indication are preset for the main and cross streets. The green signal is illuminated for the minimum period of time even when there is no traffic on the street. When there is traffic on the main street within the minimum period of time, the green signal indication for the main street is extended a predetermined period of time for every one vehicle. However, such extension is limited to the maximum period of time.

In accordance with a control type selection signal from the master controller, the fixed-time control unit 7 can be connected to the unit 6 or both the units 4 and 6 so as to provide traffic-actuated control or coordinated traffic-actuated control. Independently of the master controller and the units 4 and 6, the fixed-time control unit 7 functions as a fixed-time traffic signal controller. In order to provide a traffic-actuated control, the fixed-time control unit 7 receives the signals from the traffic-actuated con-

3

trol unit 6 only and not from the coordinated control unit 4; while in order to effect a coordinated traffic-actuated control, the unit 7 receives the signals from the unit 4, and the main-street green signal terminating signals and the cross-street green signal terminating signals from the unit 6.

In the illustrated embodiment the local controller is adapted to control the signal indication for the main and cross streets, and provide two-phase control, that is, a phase for permitting traffic movement on the main street and a subsequent phase for permitting traffic movement on the cross street.

FIG. 2 is a time chart illustrating the signal indications in accordance with the two-phase control system. Here, the symbols X, Y and Z represent green, amber and red signal indications, respectively; and the prefixed numerals 1 and 2 represent that the signal indications are for the main street and the cross street, respectively. As shown, the green signal indication 1X for the main street begins simultaneously with the red signal indication 2Z for the cross street at time M4; the red signal indication 1Z for the main street being at time M2 at the same time as the green signal indication 2X for the cross street; and the amber signal indication Y for each street occurs for a predetermined period of time before the red signal indication for the other street ends. The amber signal indication 1Y and 2Y for the main and cross streets begin at times M1 and M3, respectively. Then, four conditions exist between M4 and M1 (with 1X and 2Z), M1 and M2 (with 1Y and 2Z), M2 and M3 (with 1Z and 2X) and M3 and M4 (with 1Z and 2Y). These four conditions will be referred to as conditions (0), (1), (2) and (3), respectively, as shown in FIG. 2c.

When the fixed-time control is being performed by the unit 7, the four conditions (0), (1), (2) and (3) take place successively, the time period of each of the conditions having been predetermined.

When the traffic-actuated control is being performed, if more traffic is on the main street, the condition (0) must be extended, while if more traffic is on the cross street, the condition (2) must be extended. If a pulse counter is employed to determine the percentages of the four conditions to one signal cycle, in order to vary the percentages of conditions (0) and (2) the operation of the pulse counter must be stopped in the course of conditions (0) and (2). This is schematically shown in FIG. 2d. As shown, the counter is stopped at time L1 a predetermined period of time after the start of the condition (0) and is resumed at time U after passage of the maximum time period of green signal indication for the main street, or upon production of a no-traffic-on-the-main-street signal after passage of the minimum time period of green signal indication. Then after a predetermined period of time the condition (1) is brought into existence at time M1. The amber signal indication is set to the same duration for both the main and cross streets, so that the conditions (1) and (3) are of the same duration. Similarly, the counter is stopped at L2, that is, a predetermined period of time after the end M2 of the condition (1), and resumed at V after passage of the maximum time period of green signal indication for the cross street or upon production of a no-traffic-on-the-cross-street signal after passage of the minimum time period of green signal indication for the cross street. Then after a predetermined period of time the condition (3) is brought about at M3.

When traffic control is being performed in accordance with the coordinated traffic-actuated system, with a predetermined signal cycle (the period of time between M4 and the next M4) and a predetermined period of time for green signal indication, the cycle of conditions (0), (1), (2) and (3) is normally repeated. However, if there is no traffic on the main street, the vehicle detectors detect the absence of traffic and produces a corresponding signal. If this signal is produced before the coordi-

4

nated control unit 4 produces a signal for terminating the green signal indication for the main street, the time period of green signal indication for the main street, that is, 1X, is shortened, and consequently the green signal indication 2X for the cross street is started earlier than otherwise.

FIG. 3 is a schematic diagram illustrating a circuit for selecting the desired one of the above-mentioned control types. The circuit comprises input terminals 3T1 to 3T7, diodes 3D1 and 3D2, AND elements 3A1 and 3A2, and OR elements 3R1 to 3R3. The terminal 3T1 is adapted to receive a signal V10 for initiating green signal indication for the main road; the terminal 3T2, a signal V20 when there is no traffic on the cross street; the terminal 3T3, a signal U10 for terminating the green signal indication for the main street; the terminal 3T4, a signal U20 when there is no traffic on the main street; the terminal 3T5, a signal for selecting the traffic-actuated control and a signal for selecting the coordinated traffic-actuated control; the terminal 3T6, a signal X2 which is produced while the signal indication for the cross street is green; and the terminal 3T7, a signal X1 which is produced while the signal indication for the main street is green. The signal V10 is produced by the coordinated control unit 4 a preset period of time, that is, offset after the local controller received a synchronizing signal which is supplied from the master controller in the same cycle as the signal cycle. The signal V20 is produced by the unit 6 when the maximum green signal period for the cross street has passed or when there is no traffic on the cross street after the minimum green signal period has been extended by a predetermined period of time per vehicle. The signal V20 terminates the green signal indication for the cross street and begins that for the main street. The signal U10 is produced by the unit 4 to terminate the green signal indication for the main street which was initiated by the signal V10 after a period of time as preset by the split selection signal from the master controller. The signal U20 is produced by the unit 6 to terminate the green signal indication for the main street. Both the traffic-actuated control selection signal and the coordinated traffic-actuated control selection signal are supplied from the master controller 1. Here, the traffic-actuated control selection signal is a "0" signal and the coordinated traffic-actuated control selection signal is a "1" signal.

When the coordinated traffic-actuated control selection signal coincides with the main-street-green-signal-initiating signal V10 on the main-road-green-signal-terminating signal U10, an output appears at the anode of the diode 3D1 or 3D2. While the signal indication is green for the cross street, the signal X2 is being applied to the terminal 3T6; and while the signal indication is green for the main street, the signal X1 is being applied to the terminal 3T7. The signals U10 and U20 are applied at time U, and the signals V10 and V20, at time V in FIG. 2.

FIG. 4 shows a time-presetting circuit employed in the invention. The circuit comprises a pulse generator 4S1 designed to produce one pulse per second, a MEMORY element 4F1, OR elements 4R1 to 4R3, a pair of decimal pulse counters 4C1 and 4C2, an INHIBIT element 4H1, six pinboards 4B1 to 4B6, and an input terminal 4T1 for an operating voltage to be applied to. Each pinboard comprises a resistor r and a plurality of pinholes $4p$ and $4p'$ connected to the output terminals to the counters 4C1 and 4C2, and a pair of diodes 4D and 4D'. It will be seen that by inserting a pin into one of the pinholes $4p$ and another pin into one of the pinholes $4p'$, it is possible to determine the number of pulses to be counted by the counters 4C1 and 4C2 to produce an output on lines M40, M10, M20, M30, L10 and L20. The signal on each of these lines will be designated by the symbol indicating that line. For example, the signal on line M40 will be referred to as the signal M40.

5

When the signal M40 appears, this signal will be applied through the INHIBIT element 4H1 to the counters to reset them. The pinboards 4B1 to 4B4 are preset so that the signals M10 to M40 are produced at times M1 to M4, respectively, in FIG. 2, while the pinboards 4B5 and 4B6 are preset so that the signals L10 and L20 are produced at times L1 and L2, respectively, in FIG. 2.

FIG. 5 is a diagram of a phase-setting circuit of the invention. The circuit comprises a quaternary counter 5C1 provided with four output terminals (0) to (3) and six pinboards 5B1 to 5B6. Each pinboard comprises four pinholes connected to the output terminals of the counter 5C1, and four diodes 5D to form a diode OR circuit having an output terminal 5T1 to 5T6. The output conditions of the output terminals (0), (1), (2) and (3) of the counter 5C1 correspond to the conditions (0), (1), (2) and (3) in FIG. 2, respectively, with a pin being inserted into pinholes 5p10, 5p21, 5p32, 5p33, 5p42, 5p53, 5p60 and 5p61 as shown hatched in FIG. 5. This will enable the two-phase control of the illustrated embodiment of the invention.

The signals X1, Y1 and Z1 for effecting green, amber and red signal indications 1X, 1Y and 1Z for the main street appear at the terminals 5T1, 5T2 and 5T3, respectively; while the signals X2, Y2 and Z2 for effecting green, amber and red signal indications 2X, 2Y and 2Z appear at the terminals 5T4, 5T5 and 5T6, respectively. These signals are applied the signal lighting device to turn on the corresponding signal lights.

When an output appears at the terminal (0) of the counter 5C1, the signals X1 and Z2 appear, bringing about the condition (0) in FIG. 2; when an output appears at the next terminal (1) of the counter 5C1, the signals Y1 and Z2 appear, bringing about the condition (1); when an output appears at the terminal (2), the signals Z1 and X2 appear, effecting the condition (2); and when an output appears at the last terminal (3), the signals Z1 and Y2 appear, effecting the condition (3).

Now is the time to explain the operation of the system of the invention as it performs each of the three types of traffic signal control, that is, fixed-time, traffic-actuated, and coordinated traffic-actuated controls.

Fixed-time control

Let it be assumed that one signal cycle is 95 seconds, and that the green, amber, red signal indications for the main street last 50, 5 and 40 seconds, respectively, and the green, amber and red signal indications for the cross street last 35, 5 and 55 seconds, respectively. In order to preset the signal indications to the above durations, the pinboards 4B4, 4B1, 4B2 and 4B3 may be set to 95, 50, 55 and 90 counts, respectively. The pinboards 4B5 and 4B6 are set to more than 95 counts, for example, 99 counts, in order that the output from these pinboards may not set the MEMORY element 4F1. When the counters have counted 50 pulses, that is, 50 seconds have passed, the signal M10 appears; 5 seconds after that the signal M20 appears; 35 seconds thereafter the signal M30 appears; and in 5 more seconds the signal M40 appears. Thus a total of 95 seconds have passed, whereupon the counters are reset, after which the same operation will be repeated.

The signals M10 to M40 are applied through the OR element 4R2 and a line 40 to the counter 5C1. When the signal M40 is applied to the counter 5C1, the counter produces an output at the terminal (0), so that the signals X1 and Z2 appear at the terminals 5T1 and 5T6, respectively, bringing about the condition (0). Then after 50 seconds the signal M10 is produced and applied to the counter 5C1, which produces an output at the terminal (1), so that the signals Y1 and Z2 appear, bringing about the condition (1). Then after 5 seconds the signal M20 appears and the counter 5C1 produces an output at the terminal (2), so that the signals Z1 and X2 appear, bringing about the condition (2). Then after 35 seconds the

6

signal M30 appears and causes the counter to produce an output at the terminal (3), so that the signals Z1 and Y2 appear, bringing about the condition (3). Then after 5 more seconds the signal M40 appears again, so that the original condition (0) is restored.

In the above example, the conditions (0) to (3) last 50, 5, 35 and 5 seconds, respectively. The durations may be varied by varying the counts preset on the pinboards 4B1 to 4B4.

Traffic-actuated control

In this case, the master controller 1 applies the traffic-actuated control selection signal to the terminal 3T5. Under the condition, when the no-traffic-on-the-cross-street signal V20 or the no-traffic-on-the-main-road signal U20 is applied to the terminal 3T2 or 3T4, the signal V20 or U20 is applied through the OR element 3R1 or 3R2 to one of the input terminals of the AND element 3A1 or 3A2.

Suppose that the pinboards 4B1 to 4B6 are preset to 10, 15, 25, 30, 8 and 23 counts, respectively. When the signal M40 appears, the counters 4C1 and 4C2 are reset to provide the condition (0). Then after 8 seconds, that is, when the counter 4C1 has counted 8 pulses, the signal L10 is produced and applied to the MEMORY element 4F1 to make it produce an output from its "0" section. The output is applied through the OR element 4R1 to the counter 4C1 to stop its counting operation. Since the output condition of the OR element 4R1 remains unchanged until the MEMORY element 4F1 is reset, the counter 4C1 is kept stopped and consequently the condition (0) continues until resetting of the element 4F1. Under the condition, when the maximum period of the green signal indication for the main street has passed, or when after passage of the minimum period of the green signal indication for the main street the no-traffic-on-the-main-street signal U20 is produced, this signal U20 is applied to one input of the AND element 3A2. On the other hand, the signal indication for the main street is green at this time and the signal X1 is applied through the terminal 3T7 to the other input of the AND element 3A2, so that the element produces an output, which is applied through the OR element 3R3 and the line 30 to the "1" section of the MEMORY element 4F1 to reset it, whereupon the output of this element becomes zero, so that the counters 4C1 and 4C2 resume their counting operation. Then after 2 seconds, that is, when two pulses from the generator 4S1 have been counted, the signal M10 appears, bringing about the condition (1). Then after 5 seconds the signal M20 appears, bringing about the condition (2). Then after 8 seconds, the signal L20 appears so as to set the MEMORY element 4F1, thereby stopping the operation of the counters in the manner previously mentioned and maintaining the condition (2). Under the condition, when the maximum period of green signal indication for the cross street has passed or when the no-traffic-on-the-cross-street signal V20 is applied to the terminal 3T2, the OR element 3R1 produces an output. At this time the signal indication for the cross street is green, with the signal X2 being applied to the terminal 3T6, so that the AND element 3A1 produces an output, which is applied through the line 30 to the MEMORY element 4F1 to reset the same, whereupon the counters resume their counting operation. Then in 2 seconds the signal M30 appears, bringing about the condition (3). Then after 5 seconds the signal M40 again appears, and the original condition (0) is restored.

Coordinated traffic-actuated control

In this case, the master controller 1 applies the coordinated traffic-actuated selection signal to the terminal 3T5. Under the condition, when the main-street-green-signal-indication initiating signal V10 or the no-traffic-on-the-cross-street signal V20 is applied to the terminal 3T1 or 3T2, the OR element 3R1 produces an output, and when the main-street-green-signal-indication terminating

signal U10 or the no-traffic-on-the-main-street signal U20 is applied to the terminal 3T3 or 3T4, the OR element 3R2 produces an output. For this type of control, the pinboards 4B1 to 4B6 may be preset to the same numbers of counts as in the traffic-actuated control, that is, 10, 15, 25, 30, 8 and 23 counts, respectively. Then referring to FIG. 2, the time period between M4 and L4 ($\overline{M4L4}$) will be 8 seconds; $\overline{UM1}$, 2 seconds; $\overline{M1M2}$, 5 seconds; $\overline{M2L2}$, 8 seconds; $\overline{VM3}$, 2 seconds; and $\overline{M3M4}$, 5 seconds. Suppose that one signal cycle is 160 seconds and that the period of time between the signals V10 and U10 ($\overline{M4M2}$) is 95 seconds. The time periods $\overline{L1U}$ and $\overline{L2V}$ will be 80 and 50 seconds, respectively.

Now referring to FIG. 4, when the signal M40 is produced, the counters 4C1 and 4C2 are reset, so that the condition (0) is brought about in the same manner as previously mentioned. The after 8 seconds, that is, when 8 pulses have been counted by the counter 4C1, the signal L10 appears so as to be applied to the MEMORY element 4F1 to set the same, whereupon this element produces an output to be applied through the OR element 4R1 to the counter 4C1 to stop the counting operation, thereby maintaining the condition (0). Then after 80 seconds the signal U10 is produced, or before that, the signal U20 may be produced if there is no traffic on the main street. Upon production of the signal U10 or U20, the OR element 3R2 produces an output, which will be applied through the AND element 3A2, the OR element 3R3 and the line 30 to the MEMORY element 4F1 to reset the same, whereupon the existing output of the MEMORY element disappears, so that the counters 4C1 and 4C2 resume their counting operation. Then in 2 seconds the signal M10 appears and is applied through the OR element 4R2 and the line 40 to the counter 5C1, which produces an output at the terminal (1) so that the signal Y1 appears at the terminal 5T2, with the signal Z2 at the terminal 5T6, thereby effecting the condition (1). Then after 5 seconds the signal M20 appears, so that the counter 5C1 produces an output at the terminal (2) and the signal Z1 and X2 appear at the terminal 5T3 and 5T4, thereby effecting the condition (2). Then after 8 seconds the signal L20 is produced so as to set the MEMORY element 4F1, thereby stopping the operation of the counters 4C1 and 4C2 and keeping the condition (2).

Under the condition (0), if the signal U20 appears earlier than the signal U10, that is, no traffic is detected on the main street any longer, the signal U20 causes the OR element 3R3 to produce an output, which is applied through the line 30 to the MEMORY element 4F1 to reset the same, whereupon the counters 4C1 and 4C2 resume their counting operation. This means that the condition (0), that is, the time period between M4 and M1 (FIG. 2) is shortened. Since the cycle length is fixed, the shortening of the duration of the condition (0) causes a corresponding extension of the duration of the condition (2). This means that the time period between L2 and V and consequently the green signal indication for the cross street becomes longer.

Under the condition (2), when the signal V10 is applied to the terminal 3T1, the AND element 3A1 produces an output which is applied through the OR element 3R3 to the MEMORY element 4F1 to reset the same, so that the counters 4C1 and 4C2 resume counting. Then in 2 seconds the signal M30 appears so as to be applied through the line 40 to the counter 5C1 to make it produce an output at the terminal (3), whereupon the signals Z1 and X2 appears, effecting the condition (3). Then after 5 seconds the signal M40 appears again with resulting restoration of the condition (0).

Having illustrated and described a preferred embodiment of the invention, it should be recognized that the embodiment is merely representative of the invention, and that there are many modifications and changes without departing from the scope of the invention as defined in

the appended claims. For example, instead of using the signals L10 and L20 to stop the counting operation of the counters 4C1 and 4C2, the signals M40 and M20 may be utilized for the same purpose by connecting the output lines of the pinboards 4B4 and 4B1 or the output terminals (0) and (2) of the counter 5C1 to the set terminal of the MEMORY element 4F1. Instead of the two-phase control, a multi-phase control may also be possible by increasing the number of the pinboards 4B, the counting capacity of the counter 5C1 and the number of the pinboards 5B.

What we claim is:

1. A local traffic signal controller comprising: a pulse generator; means for counting the pulses from said generator; a MEMORY element associated with said counting means so that the output of said MEMORY element stops the counting operation of said counting means; means for setting predetermined time periods comprising a plurality of circuits each of which is connected to the output terminals of said mounting means so as to produce an output when said counting means has counted a preset number of pulses from said generator, the output of at least one of said plurality of circuits being adapted to set said MEMORY element to produce an output, and the output of at least one of said plurality of circuits being adapted to reset said pulse counting means; means for resetting said MEMORY element; and phase-setting means comprising a second counting means for counting the output pulses from said plurality of circuits and a second plurality of circuits connected to the output terminals of said second counting means to produce an output when said second counting means has counted a preset number of pulses from said first plurality of circuits, the output from each of said second plurality of circuits being used to control the signal lights.

2. The local traffic signal controller as defined in claim 1, wherein said resetting means comprises first circuit means adapted to be actuated by traffic on the crossing streets to produce a signal corresponding to the traffic condition thereon to be applied as a reset signal to said MEMORY element.

3. The local traffic signal controller as defined in claim 2, wherein said resetting means further includes second circuit means controlled by a master controller to produce a signal for initiating the green signal indication for the main street and a signal for terminating said green signal indication, said signals being selectively applied as a reset signal to said MEMORY element.

4. The local traffic signal controller as defined in claim 3, wherein said resetting means further includes third circuit means controlled by said master controller to inhibit said signals from said second circuit means.

5. The local traffic signal controller as defined in claim 1, wherein said first plurality of circuits comprise pinboards each having a plurality of pinholes connected to the output terminals of said first counting means.

6. The local traffic signal controller as defined in claim 1, wherein said second plurality of circuits comprise pinboards each having a plurality of pinholes connected to the output terminals of said second counting means.

7. A local traffic signal controller comprising: a pulse generator; means for counting the pulses from said generator; a MEMORY element associated with said counting means so that the output of said MEMORY element stops the counting operation of said counting means; means for setting predetermined time periods comprising a plurality of circuits each of which is connected to the output terminals of said counting means so as to produce an output when said counting means has counted a preset number of pulses from said generator, the output of at least one of said circuits being adapted to reset said pulse counting means; phase-setting means comprising a second counting means for counting the output pulses from said plurality of circuits and a second plu-

ality of circuits connected to the output of said second counting means to produce an output when said second counting means has counted a preset number of pulses from said first plurality of circuits, the output from each of said second plurality of circuits being used to control the signal lights, and the output from at least one of the output terminals of said second counting means being used to set said MEMORY element; and means for resetting said MEMORY element.

5

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THOMAS B. HABECKER, Primary Examiner
U.S. Cl. X.R.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,500,309 Dated March 10, 1970

Inventor(s) Hiroo Watanabe, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Following the title and in the heading:

-- Priority of Japanese Application Serial
No. 40-55544 filed September 9, 1965,
claimed. --

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SEALED
NOV 24 1970

(SEAL)

Attest

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents