June 18, 1957 E. J. SCHULENBURG 2,796,595

TRAFFIC CONTROL SYSTEM

Filed April 12, 1955 2 Sheets-Sheet 1

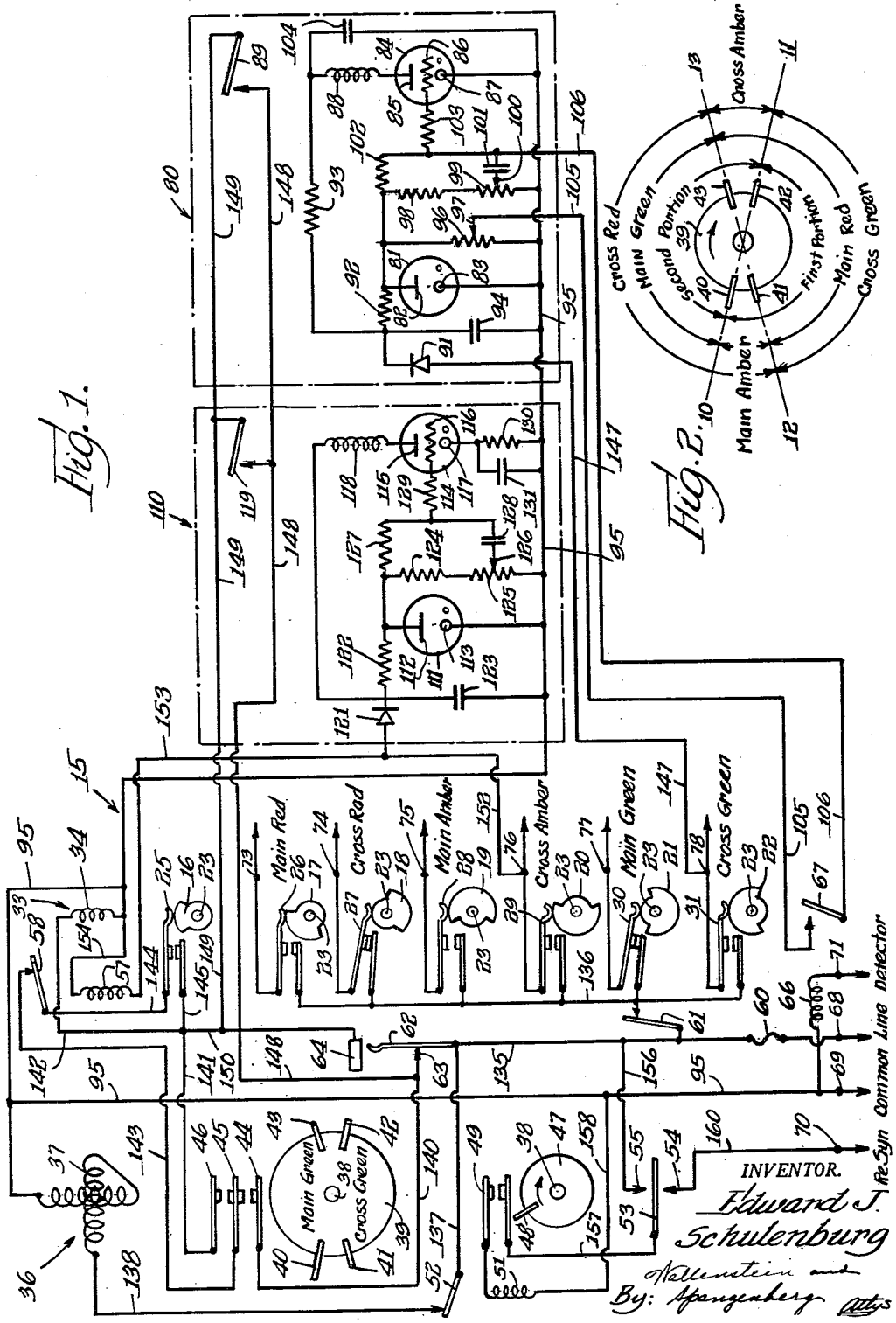


Fig. 1.

Fig. 2.

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Fig. 3. Fig. 4. Fig. 5. Fig. 6.

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United States Patent Office 2,796,595 Patented June 18, 1957

2,796,595

TRAFFIC CONTROL SYSTEM

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Application April 12, 1955, Serial No. 500,759

12 Claims. (Cl. 340—37)

This invention relates to control means for traffic control systems having stop, go and change signals for controlling main and cross traffic at cross intersections.

The principal object of this invention is to provide an improved control means for a traffic control system having stop, go and change signals at each of a plurality of cross intersections along a main traffic artery for controlling main and cross traffic at said cross intersections, wherein the stop, go and change signals are operated at each cross intersection through recurring control cycles, wherein each control cycle includes a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, wherein the first portion of the control cycle is started at each cross intersection at predetermined time intervals in timed relation with the other cross intersections to control the main and cross traffic for providing substantially uniform traffic flow in the main direction along the main traffic artery, wherein the second portion of the control cycle at each traffic intersection is started as soon as the cross traffic at that intersection terminates during the first portion of the control cycle, and wherein the second portions of the control cycles are started at each cross intersection at predetermined time intervals and in timed relation with the control cycles at the other cross intersections if the second portions of the control cycles have not already been started.

Thus, the stop, go and change signals at the various cross intersections along the main artery are operated by the control means of this invention in timed relation to provide uniform flow of traffic in the main direction along the main traffic artery and to allow for cross traffic at the various cross intersections, proper time intervals being set up for the main and cross traffic toward this end. If the cross traffic at any cross intersection is absent or prematurely terminates, the remaining time allocated for that cross traffic is then immediately allocated to the flow of the main traffic. In other words, in accordance with this invention, the main traffic is given at least a minimum time interval during each control cycle to proceed through a cross intersection and, if and as the cross traffic at that cross intersection permits, the time interval for clearance of the main traffic is correspondingly increased. At the same time the traffic control system remains completely synchronized along the main traffic artery.

Further objects of this invention reside in the details of and the cooperative relationships between the component parts of the traffic control means of this invention for carrying out the principal object of this invention.

Other objects and advantages of this invention will become apparent to those skilled in the art upon reference to the accompanying specification, claims and drawings, in which:

Fig. 1 is a diagrammatic illustration of the traffic control means of this invention;

Fig. 2 is a polar diagram illustrating the ultimate operation of the control means of this invention at one of the cross intersections;

Figs. 3, 4, 5 and 6 are diagrams showing the positions of the various parts of the traffic control means of this invention during various periods of the control cycle.

The ultimate operation of the traffic control means of this invention is diagrammatically illustrated in Fig. 2 wherein there is illustrated, in polar diagram form, one of the recurring control cycles at a cross intersection. The diagram illustrates traffic control in two directions, namely, main direction and cross direction. A complete control cycle extends in a counterclockwise direction from the line **10** back to the line **10**. This complete control cycle is broken up into two portions, the first portion extending between the lines **10** and **11** and the second portion extending between the lines **11** and **10**. The first control cycle portion has a traffic change signal for the main direction (main amber) extending from line **10** to line **12**, a traffic stop signal for the main direction (main red) extending from the line **12** through the line **11** to the line **13** and a traffic go signal for the cross direction (cross green) extending from the line **12** to the line **11**. The second control cycle portion has a traffic change signal for the cross direction (cross amber) extending from the line **11** to the line **13**, a traffic stop signal for the cross direction (cross red) extending from the line **13** through the line **10** to the line **12**, and a traffic go signal for the main direction (main green) extending from the line **13** to the line **10**. Beginning with the first control cycle portion there appears a traffic change signal for the main direction. Upon termination of this traffic change signal there is a traffic stop signal for the main direction and a traffic go signal for the cross direction which continue to the end of the first control cycle portion. At the termination of the first control cycle portion there then appears a traffic change signal for the cross direction and following this traffic change period there appears a traffic stop signal for the cross direction and a traffic go signal for the main direction which signals extend to the end of the second control cycle period. While as illustrated, the main red signal extends over into the traffic change period for the cross traffic of the second control cycle period and, likewise, the cross stop signal of the second control cycle portion extends over into the traffic change period for the main direction of the first control cycle portion, these stop signals, if desired, may be terminated at the ends of their respective control cycle periods and traffic change signals substituted therefor. While two directions of traffic control, main and cross, have been illustrated, it is apparent that any number of directions may be controlled by suitable alteration of the traffic control means. Also, the traffic change periods (main and cross amber) may encompass other periods involving pedestrian walk and the like.

The traffic control means of this invention is automatically adjustable in accordance with the cross traffic at the particular intersection to advance the termination of the first portion of the control cycle and the starting of the second portion of the control cycle. In other words, when the cross traffic at the particular cross intersection permits, the lines **11** and **13**, as illustrated in Fig. 2, are automatically advanced in order to provide as great a flow as possible of the traffic along the main traffic artery.

Referring now to Fig. 1 a control means for a single cross intersection is illustrated and it includes a control switch means, generally designated at **15**, for controlling the stop, go and change signals at that cross intersection. This control switch means **15** may take the form of the control switch means shown and described in Edward J.

Schulenburg Patent No. 2,671,148, issued March 2, 1954. For purposes of illustration herein, it is shown to include a plurality of cams **16** to **22** carried by a cam shaft **23**, which shaft, for simplicity, is shown to be intermittently advanced in a clockwise direction 90 rotative degrees per step. The cam **16** operates a switch **25** which is an interlock switch operating in conjunction with a first timing means generally designated at **36**. The cam **17** operates a switch **26** which controls the main red traffic signal. The cam **18** operates a switch **27** which controls the cross red traffic signal. The cam **19** operates a switch **28** which controls the main amber, or main traffic change, signal. The cam **20** operates a switch **29** which controls the cross amber traffic signal and which also controls a third timing means generally designated at **110**. The cam **21** operates a switch **30** which controls the main green traffic signal. The cam **22** operates a switch **31** which controls the cross green traffic signal and also a second timing means generally designated at **80**.

The cam shaft **23** is intermittently advanced by means of a solenoid actuator generally designated at **33** and which may take the form illustrated and described in Edward J. Schulenburg Patent No. 2,682,004, issued June 22, 1954. The solenoid actuator contains a pawl and rachet (not shown) for intermittently advancing the cam shaft **23**, the pawl and rachet being operated by a solenoid winding **34**. The arrangement is such that, when the solenoid winding **34** is energized, the pawl is cocked or positioned so that upon deenergization of the solenoid winding **34**, the pawl advances to step the cam shaft **23** through 90 rotative degrees in the clockwise direction. In other words, energization of the solenoid **34** merely cocks the actuator and the cam shaft **23** is not advanced until the solenoid **34** is deenergized.

The first timing means for controlling the solenoid actuator **33** and hence the control switch means **15** for starting the control cycle portions is generally designated at **36**. It includes a normally continuously operating constant speed electric motor having windings **37** for rotating at constant speed a shaft **38**. The shaft **38** carries a timing dial **39** upon which are adjustably positioned cam members **40**, **41**, **42** and **43**, the cam member **40** being longer than the other cam members **41**, **42** and **43**. These cam members **40**, **41**, **42** and **43**, upon rotation of the timing dial **39**, operate a switch having three contact blades **44**, **45** and **46**. When the long cam member **40** engages the contact blade **44**, the three contact blades **44**, **45** and **46** are brought together to complete an electrical circuit between the outer contact blades **44** and **46**. When, however, the shorter contact members **41**, **42** and **43** engage the contact blade **44**, the contact blade **44** is moved into engagement with the contact blade **45**, thus completing an electrical circuit only between the contact blades **44** and **45**. Under these conditions the contact blade **45** is not moved into engagement with the contact blade **46**. This switch comprising these contact blades **44**, **45** and **46** cooperates with the interlock switch **25** for controlling the solenoid actuator **33**. The first timer **36** also includes a synchronizing dial **47** carried by the shaft **38**, this synchronizing dial adjustably carrying a cam member **48** which is adapted upon rotation of the synchronizing dial **47** to engage and close a switch **49**.

Associated with the synchronizing switch **49** is a relay having an operating coil **51** and a normally closed switch **52**. When the relay coil **51** is deenergized the switch **52** is closed and, conversely, when the relay coil **51** is energized the switch **52** is opened. Associated with the synchronizing switch **49** and the relay coil **51** is a synchronizing control switch having a center switch blade **53** and contacts **54** and **55**, this control switch being a three position single-pole double-throw switch.

Associated with the solenoid actuator **33**, the interlock switch **25** and the switch blades **44** and **45** is a relay having an operating coil **57** and a switch **58**, which switch is normally closed. When the relay coil **57** is deenergized the switch **58** is closed and when it is energized the switch **58** is opened.

The control means of this invention also includes a fuse **60** for electrically protecting the system and a manually operated switch **61** for extinguishing the stop, go and change signals. It also includes a jack arrangement having a spring contact **62**, normally engaging a contact **63**, and a collar **64**. When a jack is inserted in the collar **64** the spring contact **62** is moved out of engagement with the contact **63** so that the system may be manually operated by a remote push button. The control means of this invention also includes a relay having a relay coil **66** and a normally opened switch **67**. When the relay coil **66** is deenergized the switch **67** is opened and when it is energized the switch **67** is closed.

Power is supplied to the control means of this invention through power terminals **68** and **69**, the terminal **68** being the hot or line terminal and the terminal **69** being the common or ground terminal. A terminal **70** is provided for connecting the control means to a master controller for automatic synchronizing purposes. A terminal **71** is provided for connection to a traffic detector. The traffic detector is located in the cross traffic stream adjacent the cross intersection and is operated by cross traffic entering the intersection. One side of the traffic detector is electrically connected to the hot line and the other side is electrically connected to the terminal **71**. Since the relay coil **66** is connected across the terminals **69** and **71** the relay coil **66** is momentarily energized each time that a vehicle enters the cross intersection from the cross direction.

The switches **26**, **27**, **28**, **29**, **30** and **31** are connected to terminals **73**, **74**, **75**, **76**, **77** and **78**, respectively, which in turn are electrically connected to the main red signals, the cross red signals, the main amber signals, the cross amber signals, the main green signals and the cross green signals, respectively. These terminals when energized by their respective switches supply electrical energy to the respective signals and, of course, the other sides of the signals are connected to the common or ground line.

The control means of this invention includes a second timing means generally designated at **80** which may be of any suitable construction. It is shown here to be an electronic timer having a voltage regulating gaseous diode tube **81** including a plate **82** and a cathode **83**, such as an OB2 tube. It also includes a geseous triode tube **84** having a plate **85**, a grid **86** and a cathode **87**, such as a 5823 tube. Located in the plate circuit of the tube **84** is a relay having a coil **88** and a normally opened switch **89**. When the relay coil **88** is deenergized, the switch **89** is opened and when it is energized the switch **89** is closed. Power is supplied to the timer **80** from the terminal **78** through a conductor **147** and a high resistance rectifier **91**. The rectifier **91** is connected through a resistance **92** to the plate **82** of the diode tube **81**, through a resistance **93** and the relay coil **88** to the plate **85** of the triode tube **84**, and through a condenser **94** to a ground conductor **95** which extends to the ground or common terminal **69**. The cathode **83** of the diode tube **81** is connected to the ground conductor **95** and the plate **82** of that tube is connected to the ground conductor **95** through a resistance **96** having an adjustable center tap **97**. The plate **82** of the diode tube **81** is also connected through a resistance **98** and a resistance **99** to the ground conductor **95**, the resistance **99** having an adjustable center tap **100**. This adjustable center tap **100** is connected through a condenser **101** and a resistance **103** to the grid **86** of the triode tube **84**. The plate **82** of the diode tube **81** is also connected through a resistance **102** and the resistance **103** to the grid **86** to the triode tube **84**. The cathode **87** of the triode tube **84** is connected to the ground conductor **95** and also the relay coil **88** is connected through a condenser **104** to the ground conductor **95**. The center tap **97** and the condenser **101** are con-

nected by conductors 105 and 106 to the switch 67 operated by the relay coil 66 in response to the flow of cross traffic at the intersection.

When electrical current is supplied to the timing means 80 through the high resistance rectifier 91 upon closure of the switch 31 which operates the cross green traffic signal, the condensers 94 and 104 are charged and likewise the condenser 101 is charged, the charging rates of the condensers 94 and 104 being greater than the charging rate of the condenser 101. The charging of the condenser 101 is regulated by the voltage regulator diode tube 81 and by the positions of the center taps 97 and 100. When the condenser 101 becomes charged the voltage of the grid 86 of the triode tube 84 is increased to fire the tube 84. When the tube 84 fires, the condensers 94 and 104 are discharged through the tube thus creating a momentary surge of current through the relay coil 88 for momentarily closing the switch 89. When the switch 67 is closed, upon entry of a vehicle into the cross intersection from the cross direction, the condenser 101 is discharged so that the charging of the condenser 101 is controlled by the cross traffic. Preferably, the charging time of the condenser 101 is substantially three seconds, or so, and if a vehicle enters the cross intersection within that time interval, the condenser is discharged and the timing means 80 reset. Thus, the condenser 101 cannot fire the tube 84 until a time interval of three seconds has occurred following energization of the timer by the switch 31 or following the last closure of the switch 67.

The control means of this invention also includes a third timing means generally designated at 110. For purposes of illustration herein this third timing means 110 is also illustrated as an electronic timer. It includes a voltage regulator gaseous triode tube 111 having a plate 112 and a cathode 113, such as an OB2 tube. It also includes a gaseous triode tube 114 having a plate 115, a grid 116 and a cathode 117, such as a 5823 tube. A relay is included in the plate circuit of the triode tube 114 and includes a relay coil 118 and a switch 119 operated thereby. The switch 119 is normally opened, it being opened when the relay coil 118 is deenergized and it being momentarily closed when the relay coil 118 is momentarily energized. Electric current is supplied to the timing means 110 from the cross amber terminal 76 through a conductor 152 and a high resistance rectifier 121. The rectifier 121 is connected by a resistance 122 to the plate 112 of the diode tube, by a condenser 123 to the ground conductor 95 and through the relay coil 118 to the plate of the triode tube 114. The cathode 113 of the diode tube 111 is connected to the ground conductor 95. The plate 112 of the diode tube 111 is connected through resistances 124 and 125 to the ground conductor 95, the resistance 125 having an adjustable center tap 126. The plate 112 of the diode tube 111 is connected through resistances 127 and 129 to the grid 116 of the triode tube 114. The center tap 126 is connected through a condenser 128 and the resistance 129 to the grid 116. The cathode of the triode tube 114 is connected through a resistance 130 and a parallel condenser 131 to the ground conductor 95 to provide grid bias for the triode tube 114.

When the terminal 76 is energized by the switch 29 to supply current to the cross amber signals, current is supplied through the rectifier 121 to charge the condenser 123 and to charge the condenser 128. The charging rate of the condenser 123 is greater than that of the condenser 128. Here also, the charging rate of the condenser 128 is regulated by the diode tube 111 and by the center tap 126. Preferably, the charging rate of the condenser 128 is about ten seconds, or so, this determining the time interval for the cross amber signal. When the condenser 128 becomes charged, the diode tube 114 is fired to discharge the condenser 123. This discharge of the condenser 123 causes a momentary current flow through the relay coil 118 for momentarily closing the switch 119.

Electric current is supplied through the fuse 60, the conductor 135, the manually operated switch 61 and conductor 136 to the switches 26 to 31, and to the terminals 73 to 78 when their associated switches are closed. In this way, the various stop, go and change signals are operated by their associated cams and switches in proper sequence as the control switch means 15 is intermittently advanced by the actuator 33.

The motor 37 of the first timing means 36 is connected across the power terminals 68 and 69 by means of a circuit extending from the line terminal 68 through the fuse 60, conductors 135 and 137, switch 52, conductor 138, motor winding 37 and conductor 95 to the common terminal 69. Thus the first timing means 36 is normally continuously operating.

With the parts in the position illustrated in Fig. 1 and with the cams in the positions illustrated in Fig. 3, the traffic control system is operating in the last part of the second control cycle portion, namely, at a point in the cycle between the lines 13 and 10 of Fig. 2. The cam 18 has its switch closed to the cross red signal with the result that the cross red signal is on. The cam 21 has its switch closed so that the main green signal is also on. All of the other cams have their respective switches opened so that the main and cross amber signals are off and the main red and cross green signals are off. The switch 25 is also opened. The first timing means 36 is operating to advance the long cam member 40 toward the timing switches 44, 45 and 46.

When the long cam member 40 closes the switches 44, 45 and 46, a circuit is completed from the line terminal 68 through the fuse 60, conductor 135, contacts 62 and 63 of the jack assembly, conductor 140, switch blades 44, 45 and 46, conductors 141 and 142, solenoid 34 and conductor 95 to the common terminal 69. This energizes the solenoid 34 which in turn cocks the solenoid actuator 33 for operation. When the long cam member 40 rides out from underneath the switch blade 44, this circuit is opened and the solenoid 34 is deenergized to advance the cams 16 to 22 through 90 rotative degrees in a clockwise direction. The cams 16 to 22 then assume the positions illustrated in Fig. 4. The cross red signal remains on, the main green signal is turned off and the cross green signal and the main red signal remain off. The main amber signal is turned on by the cam 19 which at this time closes its switch 28. Thus the traffic control system is in the traffic change period between the lines 10 and 12 of Fig. 2. At this time, the cam 16 closes its switch 25.

At the end of this traffic change period, which may extend for a time interval of 10 seconds, or so, for clearing the cross intersection, the short cam member 41 closes the switch blades 44 and 45 and when this occurs, a circuit is completed from the line terminal 68 through the fuse 60, conductor 135, jack assembly contacts 62 and 63, conductor 140, switch blades 44 and 45, conductor 143, normally closed switch 58, conductor 144, switch 25, conductors 145 and 142, solenoid 34 and conductor 95 to the common terminal 69. This energizes the solenoid 34 which in turn cocks the solenoid actuator 33. When this short cam member 41 rides out from underneath the switch blade 44 the circuit is opened and the solenoid 31 is deenergized to advance the cams 16 and 22 through 90 rotative degrees in a clockwise direction. The cams 16 to 22 then assume the position illustrated in Fig. 5. This stepping of the cams terminates the traffic change period of the first control cycle portion, as represented by the line 12 in Fig. 2. With the cams in this position, the cross red signal is turned off, the main red signal is turned on, the main amber signal is turned off, the cross amber signal remains off, the main green signal remains off and the cross green signal is turned on. Thus, the traffic control system is in the latter part

of the first control cycle portion betwen the lines **12** and **11** as illustrated in Fig. 2. The cam **16** maintains its switch **25** closed at this time.

When the cross green signal is operated during this part of the first portion of the control cycle the second timing means **80** is energized in the manner described above through the conductor **147** extending from the terminal **78**. This timer sets up a time interval of about three seconds depending upon the charging rate of the condenser **101** thereof. If, during that time interval, a vehicle enters the cross intersection from the cross direction, the relay coil **66** is momentarily energized by the traffic detector for discharging the condenser **101** which operates to reset the timer. At the end of this time interval as set by the switch **31**, controlling the cross green signal, or as reset by the traffic detector responsive to cross traffic entering the cross intersection, the relay coil **88** is momentarily energized to momentarily close the switch **89**. When the switch **89** closes a circuit is completed from the line terminal **68** through the fuse **69**, conductor **135**, contacts **62** and **63** of the jack assembly, conductor **148**, switch **89**, conductors **149**, **150** and **142**, solenoid **34** and conductor **95** to the common terminal **69**. Completion of this circuit energizes the solenoid **34** and cocks the solenoid actuator. Since the switch **89** is only momentarily closed, this circuit is then promptly broken to deenergize the solenoid **84** whereupon the cams **16** to **22** are advanced through 90 rotative degrees to the positions illustrated in Fig. 6. This operation starts the second control cycle portion as indicated by the line **11** in Fig. 2. The timer **80** therefore operates promptly to terminate the first portion of the control cycle and start the second portion of the control cycle as soon as the cross traffic at the intersection terminates. In other words, the cross green signal is operated for a minimum period of substantially three seconds or for greater times so long as cross traffic enters the intersection. When the cross traffic stops entering the intersection the second timing means **80** operates in substantially three seconds to terminate the first portion of the control cycle and start the second portion thereof.

If the cross traffic at the intersection is so heavy that vehicles continue to enter during the time allowed for the cross traffic by the timing dial **39**, then the timing dial **39** takes over to terminate the first portion of the control cycle and start the second portion thereof. In this case the short cam member **42** engages the switch blade **44** to close the switch blades **44** and **45** to complete a circuit extending from the line terminal **68** through the fuse **69**, conductor **135**, contacts **62** and **63** of the jack assembly, conductor **140**, switch blades **44** and **45**, conductor **143**, normally closed switch **58**, conductor **144**, switch **35**, conductors **145** and **142**, solenoid **34** and conductor **95** to the common terminal **69**. This circuit energizes the solenoid **34** to cock the solenoid actuator **33** for operation. When the short cam member **42** rides out from under the switch blade **44**, this circuit is broken and the solenoid **34** is deenergized to advance the cams **16** to **22** through 90 rotative degrees to the positions illustrated in Fig. 6. Thus, if the second timing means **80**, because of cross traffic, fails to terminate the first portion of the control cycle within the allowed time then the first timing means **36** operates to terminate the same and start the second portion of the control cycle.

When the control system is in the cross amber portion between the lines **11** and **13** of Fig. 2 and the cams are is on, the cross red signal is off, the main amber signal is on, the cross red signal is off, the main amber signal is off, the cross amber signal is on, the main green signal is off and the cross green signal is off. The cam **16** also maintains its switch **25** closed.

When the cam **20** so operates to close its switch **29** to operate the cross amber signal, electric current is supplied from the terminal **76** through the conductor **152** for energizing the third timing means **110**. At the same time, the relay coil **57** is energized through a circuit extending from the terminal **76** through conductors **152** and **153**, relay coil **57** and conductors **154** and **95** to the common terminal **69**. Completion of this circuit energizes the relay coil **57** to open the normally closed switch **58**. Following a time interval determined by the charging time of the condenser **128**, a time interval of substantially ten seconds, sufficient to clear the cross traffic from the intersection, the relay coil **118** is momentarily energized in the manner described above to momentarily close the switch **119**. When the switch **119** thus closes a circuit is completed from the line terminal **68** through the fuse **60**, conductor **135**, contacts **62** and **63** of the jack assembly, conductor **148**, switch **119**, conductors **149**, **150** and **142**, solenoid **34** and conductor **95** to the common terminal **69**. Completion of this circuit energizes the solenoid **34** to cock the solenoid actuator **33** for operation. Since the switch **119** is only momentarily closed, this circuit is promptly broken to deenergize the solenoid **34** whereupon the solenoid actuator **33** advances the cams **16** to **22** through 90 rotative degrees to the positions illustrated in Figs. 1 and 3. Thus the third timing means **110** operates to regulate the length of the cross amber period between the lines **11** and **13** as illustrated in Fig. 2. Since the relay coil **57** is energized to open the switch **58** during this cross amber period it is impossible to energize the solenoid **34** by the cam members **42** or **43** closing the switch blades **44** and **45**. Thus, the cam members **42** and **43** can not operate the solenoid actuator **33** during the cross amber period as determined by the third timing means **110** and started by the second timing means **80**. In other words, this opening of the switch **58** during this cross amber period prevents the control switch means **15** from getting out of proper sequence. The various cams are now in the positions illustrated in Figs. 1 and 3 and the above-described control cycle is then repeated.

In the traffic control system described above desired minimum times for the main traffic and desired maximum times for the cross traffic are provided at each intersection along the main artery and depending upon the amount of cross traffic at any cross intersection, the time for the cross traffic is automatically decreased with a corresponding increase in the time for the main traffic. In this way maximum flow of main traffic along the main artery is provided and only that amount of time required to clear the cross traffic is utilized for that purpose. This is all accomplished by automatically advancing the lines **11** and **13** as illustrated in Fig. 2, in accordance with the dictates of the cross traffic at the particular intersection.

In the foregoing description no reference has been made to the synchronizing means for the first timing means **36**, the description being predicated on the synchronizing control switch blade **53** being located in the middle position as shown in Fig. 1. By moving the switch blade **53** of the synchronizing control switch into engagement with the contact **55**, the control means of this invention may be manually synchronized to operate in conjunction with similar control means for the other traffic control signals along the main artery. The cam member **48** on the synchronizing dial **47** of the first timing means **36** is adapted to close the switch **49** in each control cycle and, as illustrated, it will close this switch **49** during the latter part of the first control cycle portion between the lines **10** and **13** of Fig. 2. When this occurs, a circuit is completed from the line terminal **68** through the fuse **60**, conductors **135** and **156**, contact **55**, switch blade **53**, conductor **157**, switch **49**, relay coil **51** and conductors **158** and **95** to the common terminal **69**. This circuit energizes the relay winding **51** to open the normally closed switch **52**, which in turn stops operation of the first timing means **36**. At the proper time, depending upon the other traffic control units along the main artery, the switch blade **53** may be moved out of engagement with the contact **55** to open this circuit and allow the switch **52** to close for restarting the timing means **36**.

Thus, the timing means 36 may be manually synchronized with the other traffic control units.

The timing means 36 may also be automatically synchronized with the other timing units along the main artery by moving the switch blade 53 into engagement with the contact 54 and this synchronizing action may take place during each control cycle of operation. In this connection, a master control, not illustrated, sends out an electrical pulse to all of the associated control units so that all of the control units may be brought into proper step, that is, automatically synchronized. The electrical pulse is conducted to the control means from the master controller through the synchronizing terminal 70 which is connected to the contact 54 by a conductor 160. This electrical pulse begins prior to the time that the cam member 48 normally engages the switch 49. When the switch 49 is closed, while the electrical pulse is present, a circuit is completed from the synchronizing terminal 70 through conductor 160, contact 54, switch blade 53, conductor 157, switch 49, relay coil 51 and conductors 158 and 95 to the common terminal 69. This energizes the relay coil 51 to open the normally closed contact 52 and stop the first timing means 36. The timing means 36 remains stopped until the pulse transmitted by the master controller ceases, whereupon the relay coil 61 becomes deenergized and the switch 52 closes to restart the first timing means 36. Thus, all of the control units along the main traffic artery are in this manner automatically synchronized by means of the master controller. The position of the cam member 48 on the synchronizing dial 47 is determined by the timed relation between the control units and preferably the cam members 48 are placed on the synchronizing dials between the lines 10 and 13 and the lines 12 and 11 so that the synchronizing times occur during the red and green periods. In this way the extents of the traffic change periods in the various control units are unaffected.

Since the timing means 36 of the various controllers along the main traffic artery are all synchronized, a uniform traffic flow along the main traffic artery is assured. At the same time, as described above, adequate time is allowed for the cross traffic at the cross intersections and if that time is not utilized by the cross traffic it is promptly allocated to the main traffic along the main traffic artery.

While for purposes of illustration one form of this invention has been disclosed, other forms thereof may become apparent to those skilled in the art upon reference to this disclosure and, therefore, this invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. Control means for a traffic control system having stop, go and change signals at each of a plurality of cross intersections along a main traffic artery for controlling main and cross traffic at said cross intersections comprising, control switch means at each cross intersection for controlling the stop, go and change signals at that intersection through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for each control switch means for sequentially operating the control switch means through said recurring control cycles, synchronized timing means at each cross intersection connected to the actuator at that cross intersection to start the first and second portions of the control cycles at predetermined time intervals and in timed relation with the timing means at the other cross intersections to control the main and cross traffic for providing substantially uniform traffic flow in the main direction, and second timing means at each cross intersection connected to the actuator at that cross intersection and including traffic detector means responsive to the cross traffic at that cross intersection for advancing the termination of the first portion and the starting of the second portion of the control cycle at that cross intersection upon the termination of the cross traffic at that intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle.

2. Control means for a traffic control system having stop, go and change signals at each of a plurality of cross intersections along a main traffic artery for controlling main and cross traffic at said cross intersections comprising, control switch means at each cross intersection for controlling the stop, go and change signals at that intersection through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for each control switch means for sequentially operating the control switch means through said recurring control cycles, synchronized timing means at each cross intersection connected to the actuator at that cross intersection to start the first portions of the control cycles at predetermined time intervals and in timed relation with the timing means at the other cross intersections to control the main and cross traffic for providing substantially uniform traffic flow in the main direction, and second timing means at each cross intersection connected to the actuator at that cross intersection and including traffic detector means responsive to the cross traffic at that cross intersection for terminating the first portion and starting the second portion of the control cycle at that cross intersection upon the termination of the cross traffic at that intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle.

3. Control means for a traffic control system having stop, go and change signals at each of a plurality of cross intersections along a main traffic artery for controlling main and cross traffic at said cross intersections comprising, control switch means at each cross intersection for controlling the stop, go and change signals at that intersection through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for each control switch means for sequentially operating the control switch means through said recurring control cycles, synchronized timing means at each cross intersection connected to the actuator at that cross intersection to start the first portions of the control cycles at predetermined time intervals and in timed relation with the timing means at the other cross intersections to control the main and cross traffic for providing substantially uniform traffic flow in the main direction, and second timing means at each cross intersection connected to the actuator at that cross intersection and including traffic detector means responsive to the cross traffic at that cross intersection for terminating the first portion and starting the second portion of the control cycle at that cross intersection upon the termination of the cross traffic at that intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle, said synchronized timing means also starting the second portions of the control cycles at predetermined time intervals and in timed relation with the timing means at the other cross intersections if the second timing means has not already started the second portion of the control cycle.

4. Control means for a traffic control system having stop, go and change signals for controlling main and cross

traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first and second portions of the control cycle at predetermined time intervals to control the main and cross traffic, and second timing means connected to the actuator and including traffic detector means responsive to the cross traffic at the cross intersection for operating the control switch means to advance the termination of the first portion and the starting of the second portion of the control cycle upon the termination of the cross traffic at the cross intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle.

5. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals to control the main and cross traffic, and second timing means connected to the actuator and including traffic detector means responsive to the cross traffic at the cross intersection for operating the control switch means to terminate the first portion and start the second portion of the control cycle upon the termination of the cross traffic at the cross intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle.

6. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals to control the main and cross traffic, and second timing means connected to the actuator and including traffic detector means responsive to the cross traffic at the cross intersection for operating the control switch means to terminate the first portion and start the second portion of the control cycle upon the termination of the cross traffic at the cross intersection for a time interval during the go signal for the cross traffic of the first portion of the control cycle, said first timing means also starting the second portion of the control cycle at predetermined time intervals if the second timing means has not already started the second portion of the control cycle.

7. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, and means including timing means and traffic detector means responsive to the cross traffic at the cross intersection connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals, to start the second portion of the control cycle when the cross traffic terminates during the first portion of the control cycle, and to start the second portion of the control cycle at predetermined time intervals if the second portion of the control cycle has not already been started.

8. Control means for a traffic control system having stop, go and change signals at each of a plurality of cross intersections along a main traffic artery for controlling main and cross traffic at said cross intersections comprising, control switch means at each cross intersection for controlling the stop, go and change signals at that intersection through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for each control switch means for sequentially operating the control switch means through said recurring control cycles, and means at each cross intersection including timing means and traffic detector means responsive to the cross traffic at that cross intersection connected to the actuator at that cross intersection for operating the control switch means to start the first portions of the control cycles at predetermined time intervals and in timed relation with the control cycles at the other cross intersections to control the main and cross traffic for providing substantially uniform traffic flow in the main direction, to start the second portion of the control cycle at each cross intersection when the cross traffic at that intersection terminates during the first portion of the control cycle, and to start the second portions of the control cycles at each cross intersection at predetermined time intervals and in timed relation with the control cycles at the other cross intersections if the second portions of the control cycles have not already been started.

9. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles,

first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals, second timing means connected to the control switch means and energized when the cross traffic go signal is operated during the first portion of the control cycle to set a time interval, traffic detector means responsive to the cross traffic connected to the second timing means for resetting the second timing means each time that cross traffic enters the cross intersection during the time interval of the second timing means, said second timing means being connected to the actuator for operating the control switch means to start the second portion of the control cycle at the end of the time interval set by the second timing means and as reset by the cross traffic.

10. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals, second timing means connected to the control switch means and energized when the cross traffic go signal is operated during the first portion of the control cycle to set a time interval, traffic detector means responsive to the cross traffic connected to the second timing means for resetting the second timing means each time that cross traffic enters the cross intersection during the time interval of the second timing means, said second timing means being connected to the actuator for operating the control switch means to start the second portion of the control cycle at the end of the time interval set by the second timing means and as reset by the cross traffic, said first timing means also being connected to the actuator for operating the control switch means for starting the second portion of the control cycle at predetermined time intervals if the second timing means has not already started the second portion of the control cycle.

11. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals, second timing means connected to the control switch means and energized when the cross traffic go

signal is operated during the first portion of the control cycle to set a time interval, traffic detector means responsive to the cross traffic connected to the second timing means for resetting the second timing means each time that cross traffic enters the cross intersection during the time interval of the second timing means, said second timing means being connected to the actuator for operating the control switch means to start the cross traffic change signal of the second portion of the control cycle at the end of the time interval set by the second timing means and as reset by the cross traffic, third timing means connected to the control switch means and the actuator and energized when the cross traffic change signal is operated to set a time interval and to operate the actuator and control switch means to start the cross traffic stop signal and the main traffic go signal of the second portion of the control cycle at the end of the time interval set by the third timing means.

12. Control means for a traffic control system having stop, go and change signals for controlling main and cross traffic at a cross intersection comprising, control switch means for controlling the stop, go and change signals through recurring control cycles, each control cycle including a first portion having a change signal and then a stop signal for the main direction and a go signal for the cross direction starting with the stop signal for the main direction and a second portion having a change signal and then a stop signal for the cross direction and a go signal for the main direction starting with the stop signal of the cross direction, an actuator for the control switch means for sequentially operating the control switch means through said recurring control cycles, first timing means connected to the actuator for operating the control switch means to start the first portion of the control cycle at predetermined time intervals, second timing means connected to the control switch means and energized when the cross traffic go signal is operated during the first portion of the control cycle to set a time interval, traffic detector means responsive to the cross traffic connected to the second timing means for resetting the second timing means each time that cross traffic enters the cross intersection during the time interval of the second timing means, said second timing means being connected to the actuator for operating the control switch means to start the cross traffic change signal of the second portion of the control cycle at the end of the time interval set by the second timing means and as reset by the cross traffic, third timing means connected to the control switch means and the actuator and energized when the cross traffic change signal is operated to set a time interval and to operate the actuator and control switch means to start the cross traffic stop signal and the main traffic go signal of the second portion of the control cycle at the end of the time interval set by the third timing means, said first timing means also being connected to the actuator for operating the control switch means to start the cross traffic change signal of the second portion of the control cycle at predetermined time intervals if the second timing means has not already started the same.

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