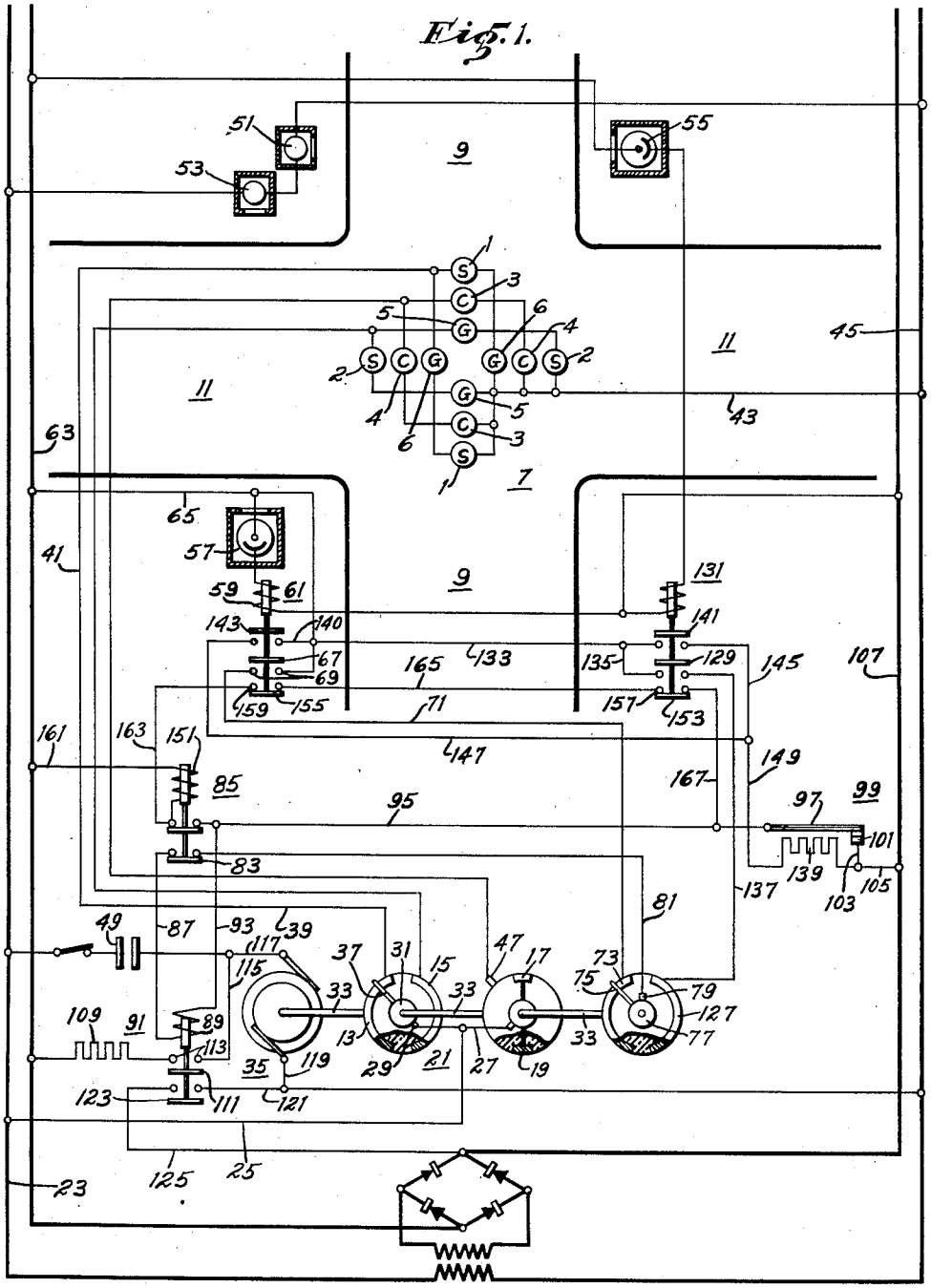
Sept. 20, 1938. R. C. HITCHCOCK 2,131,009

TRAFFIC SIGNAL

Filed May 6, 1931 3 Sheets-Sheet 1

Fig. 1.



WITNESSES:
R. S. Williams
Hymen Diamond

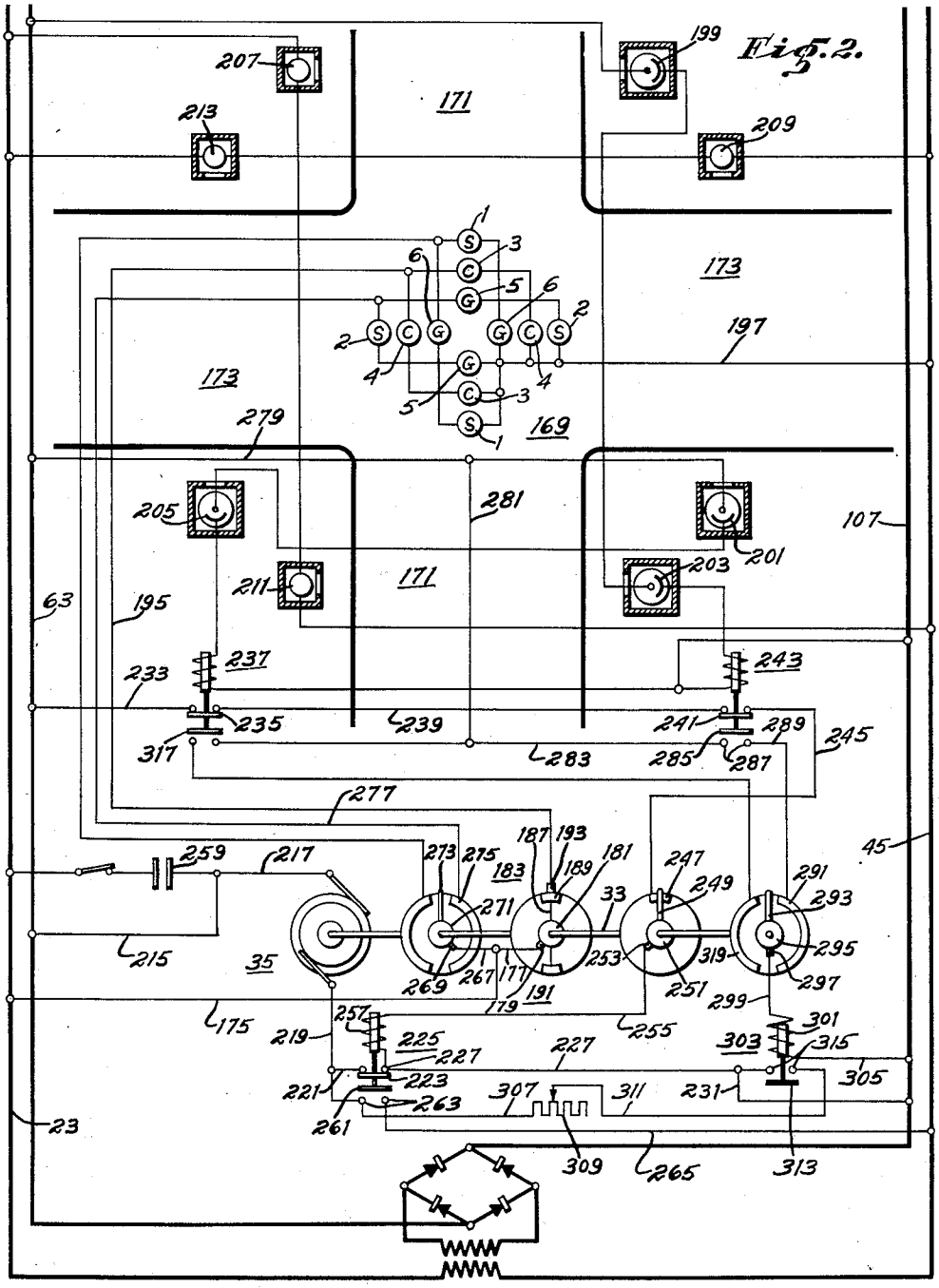
INVENTOR
Richard C. Hitchcock.

BY
Wesley G. Carr
ATTORNEY

Sept. 20, 1938. R. C. HITCHCOCK 2,131,009

TRAFFIC SIGNAL

Filed May 6, 1931 3 Sheets-Sheet 2



WITNESSES:
R. L. Williams
Hymen Diamond

INVENTOR
Richard C. Hitchcock.

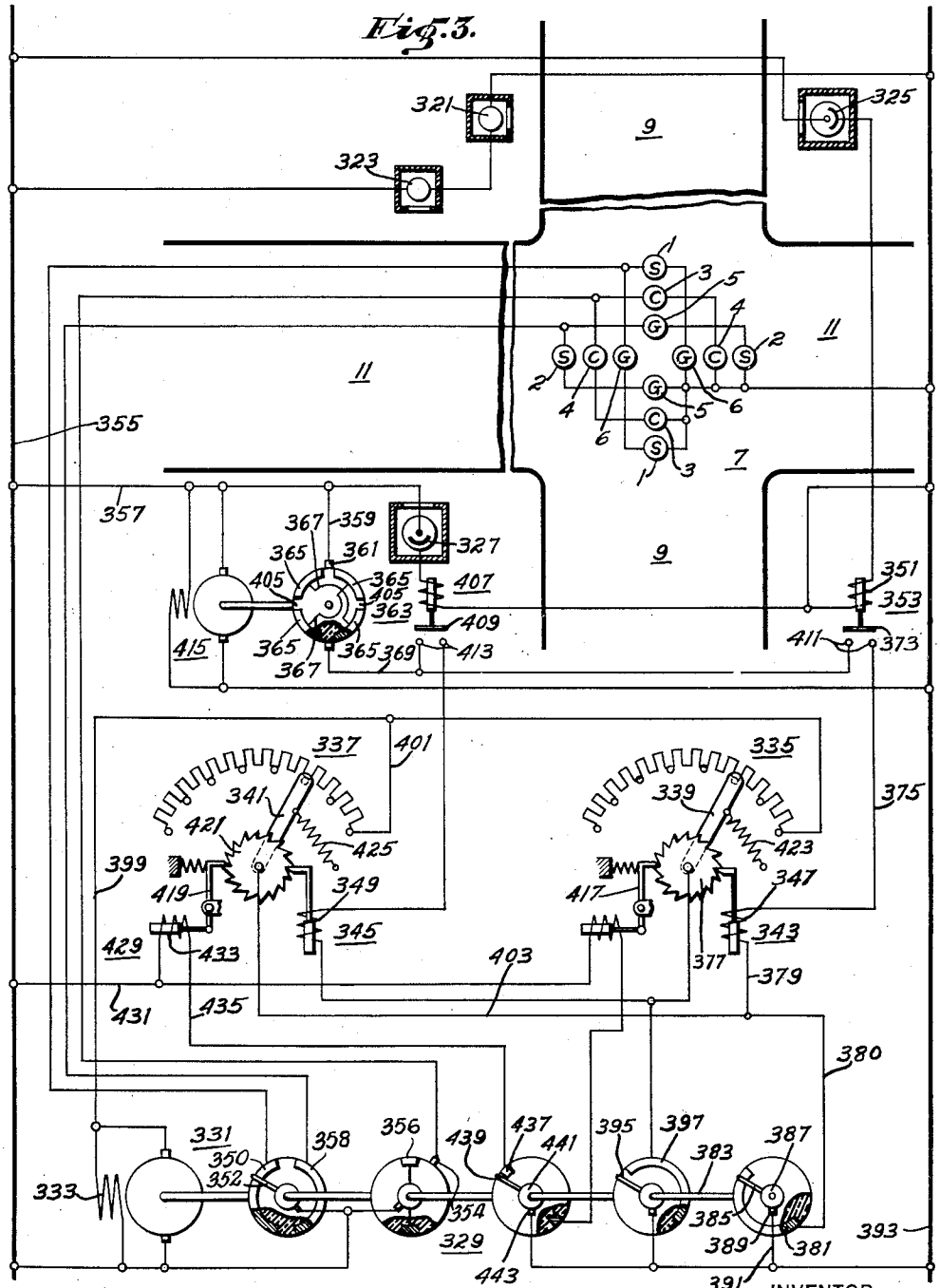
BY
Wesley G. Carr
ATTORNEY

Sept. 20, 1938. R. C. HITCHCOCK 2,131,009

TRAFFIC SIGNAL

Filed May 6, 1931 3 Sheets-Sheet 3

Fig. 3.



WITNESSES:

R. D. Williams

Hymen Diamond

INVENTOR

Richard C. Hitchcock.

BY

Shirley G. Carr

ATTORNEY

Patented Sept. 20, 1938

2,131,009

UNITED STATES PATENT OFFICE

2,131,009

TRAFFIC SIGNAL

Richard C. Hitchcock, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company, a corporation of Pennsylvania

Application May 6, 1931, Serial No. 535,366

3 Claims. (Cl. 177—337)

My invention relates to traffic-control systems and has particular relation to traffic-control systems of the type wherein the timing of signals controlling the flow of traffic along a plurality of highways is regulated by the density of the traffic along such highways.

It is an object of my invention to provide a traffic-control system for an intersection of a plurality of highways wherein the signals shall be regulated in accordance with the density of the traffic along such highways.

Another object of my invention is to provide a traffic-control system for a plurality of intersecting highways wherein the period of time during which a "go" signal is displayed along a highway shall be directly dependent upon the density of the traffic along that highway.

It is a further object of my invention to provide a traffic-control system for a plurality of highways of a type incorporating a plurality of "stop" and "go" signals to be displayed along each of the highways in a predetermined cyclical sequence, the relative duration of the "stop" and "go" signals for each highway during each cycle being dependent upon the density of the traffic along that highway.

A still further object of my invention is to provide a traffic-control system for a plurality of highways which shall incorporate a plurality of "stop" and "go" signals to be displayed along each of the highways, the duration of the display of the "go" signal along the highways being dependent upon the total number of vehicles awaiting the display of the signal.

Still another object of my invention is to provide a traffic-control system of the type that shall incorporate a plurality of "stop" and "go" signals to be displayed along a plurality of highways and a plurality of street devices, the character of the display of the "stop" and "go" signals being dependent upon the period of time during which a street device is actuated.

An incidental object of my invention is to provide for a traffic-control system of the type incorporating a plurality of "stop" and "go" signals to be displayed along a plurality of highways and a device capable of regulating the display of the signals in accordance with the density of the traffic along the highways, a contrivance that shall render the traffic-density device inactive after it has been actuated for an inordinately long period of time.

Another incidental object of my invention is to provide for a traffic-control system of the type incorporating a normally energized photo-sensitive traffic-density-regulating system, a device that shall render the traffic-density-regulating system inoperative when the photo-sensitive device associated with the system has been deenergized for an inordinately long period of time.

More concisely stated, it is an object of my invention to provide a simple and efficient traffic-density-regulating device for a traffic-control system of the type incorporating a plurality of "stop" and "go" signals to be displayed along a plurality of highways through which the traffic is of substantially equal average density.

According to my invention, I provide a traffic-control system of the type incorporating a plurality of "stop" and "go" signals to be sequentially displayed along a plurality of highways.

In a preferred embodiment of my invention, a "go" signal is displayed along one of the highways, while "stop" signals are displayed along the other highways. The signals are periodically varied in such manner that the "go" signal is given to all of the highways in turn.

The sequential operation of the signals depends upon a program controller, the segments of which are connected in series with power sources and with the signals. The program controller is driven by an induction motor which is normally energized from an alternating-current-supply source, but is capable of being energized for a short period of time from a direct-current source in response to the actuation, by a vehicle, of one of a plurality of street devices disposed along the highways. The street devices are, preferably, of the photo-sensitive type, and, when the radiations that normally energize the photo-sensitive element incorporated therein are obstructed, the direct-current-power source is instantaneously applied to the motor to effect a decrease in its speed of rotation.

The street devices are so associated with the relays, whereby the motor is energized from the direct-current source and with an appropriate rotating sector, that actuation of the street device by a vehicle is only effective in applying the direct current to the motor when the vehicle is moving along the highway for which a "go" signal is being displayed. If the vehicle is moving along a highway for which the "stop" signal is displayed, it has no effect on the relays whereby the motor is energized through the direct-current-power source.

It is apparent, therefore, that the period during which a "go" signal is displayed for one of a plurality of highways that are regulated by a traffic-control system, constructed according to

my invention, is dependent upon the densities of the traffic along such highways.

It may happen that, along a certain highway, the source whereby the photo-sensitive device is energized may be extinguished, or again, a vehicle may be stalled directly in the path of the source. In such case, the corresponding photo-sensitive device will be deenergized for an inordinately long period of time, and the motor will be operated during this period of time partly from the alternating-current-supply source and partly from the direct-current-supply source.

By reason of the fact that such situation is undesirable, I have provided a thermostatic relay that is so connected in the traffic-signal-control circuit that, if the photo-sensitive device is deenergized for an inordinately long period of time, the circuit, whereby the direct-current power is supplied to the motor, is opened and the system continues to operate in the ordinary program-control time periods until the photo-sensitive device is again energized.

In a preferred modification of my invention, the traffic signals are displayed in sequence and are varied continually. I have provided also a system wherein a "caution" signal is normally displayed along a plurality of highways. A plurality of street devices are disposed along the highways and, when one of the devices is actuated, a "go" signal is displayed for the particular highway along which the actuated street device is disposed. In such case, the traffic-signalling system passes through a cycle, and a "go" signal for the highway and a "stop" signal for the remaining highways are displayed for a predetermined period of time, determined by the number of vehicles that actuate the street device after the operation of the signalling system has been initiated.

The program controller, in apparatus of this type, is driven by an induction motor, to the terminals of which either direct current or alternating current may be applied. Normally, the "caution" signal is displayed along the highways, and direct current is applied to the induction motor. When a street device along a certain highway is actuated, the direct-current-power source is disconnected from the terminals of the motor and alternating-current power is supplied. The motor is then rotated until a "caution" signal is again displayed along the highways. During the rotation of the motor, the direct current may be intermittently applied to its terminals by the co-action of the street device and a vehicle moving along the highway for which the "go" signal is displayed.

According to a further modification of my invention, the duration of the "go" signal displayed for a highway is dependent upon the number of vehicles that were waiting for the signal to be displayed.

In this system, the program controller, whereby the sequence of the signals is regulated, is driven by a direct-current motor. The street devices are operatively associated with ratchet relays, whereby the resistance connected in the windings of the motor may be varied in accordance with the number of times the ratchets associated with the relays are actuated. The ratchets are actuated once, for each interruption of the current, through the photo-sensitive devices. Consequently, the resistance connected in series with the windings of the motor increases as the number of times that the street devices are actuated increases. In this modification of my invention, only the ratchet associated with the highway for which a "stop" signal is displayed is actuated during any given cycle.

The street devices disposed along the highways are spaced from the point at which the traffic signals are disposed and, as the vehicles actuate the particular street device associated with the highway for which the "go" signal is being displayed, the ratchet relay adds up the number of resistor elements that are to be included in series with the windings of the motor. When the "go" signal is displayed for the highway in question, the motor rotates at a speed predetermined by the number of vehicles that have actuated the street device.

By reason of the fact that the street devices are spaced from the signals, certain vehicles may actuate the street device while the "go" signal is still being displayed for the highway along which they are moving and may arrive in the vicinity of the signal after the "stop" signal has been displayed. The count of the ratchet relay will not be accurate, therefore, unless the counting starts a short time before the period of display of the "go" signal for the highway has terminated. In practice, the alternate counting of the resistor elements may be so timed that substantially all the cars waiting for a "go" signal along the highway at a predetermined instant are counted.

By reason of the fact that, in my improved traffic-control system, the street devices are ordinarily of the photo-sensitive type, the photo-sensitive element may be deenergized continuously for a comparatively long period of time by a succession of cars moving in staggered relationship along a highway. I have, therefore, provided a circuit interrupter whereby the counting continues when such situation is encountered.

The artificial counting may be adjusted in any desired manner to conform to the velocity of the vehicles as they normally move along the highway.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments, when read in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view showing the circuits of a preferred embodiment of my invention,

Fig. 2 is a diagrammatic view showing a modification of my invention wherein it is applied to a traffic-control system of the vehicle-actuated type.

Fig. 3 is a diagrammatic view showing a modification of a type wherein the timing of the signals along a highway is regulated in accordance with the vehicle traffic awaiting the "go" signal for that highway.

The apparatus shown in Fig. 1 comprises a plurality of "stop" signals 1 and 2, "caution" signals 3 and 4 and "go" signals 5 and 6 disposed at the intersection 7 of a plurality of highways 9 and 11. The signals 1, 2, 3, 4, 5 and 6 are capable of being energized through the segments 13, 15, 17 and 19 of a program controller 21 in such manner that the "stop", "caution" and "go" signals are displayed in sequence along the highways 9 and 11.

The circuit through the "stop" signals 1 along

the highway 9 and the "go" signals 6 along the other highway 11 extends from one alternating-current power-supply bus 23, through conductors 25 and 27, a brush 29 in engagement with a collar 31 secured to the shaft 33 of the program-control motor 35 and rotated thereby, a movable contactor 37 rotated by the shaft 33, the conducting segment 13 in engagement with the contactor 37, conductor 41, the "stop" signals 1 and the "go" signals 6, connected in parallel and conductor 43, to the remaining bus line 45 of the alternating-current source.

The remaining sets of "stop" and "go" signals are energized through the other segment 15 of the program controller 21 which is capable of being engaged by the contactor 37, while the "caution" signals 3 and 4 are energized through the sectors 17 and 19 that are rotated by the shaft 33 of the program-control motor 35 to engage a brush 47 during a predetermined period of its rotation.

The motor 35, whereby the program-control contactor 37 and segments 17 and 19 are rotated, is of the alternating-current induction type and is energized from the alternating-current-power source through a capacitor 49 of suitable character, the purpose of which will be explained hereinafter.

The time of display of the signals along the highways is controlled from a plurality of street devices disposed along the highways. Although the street devices may be of any of the types well known in the art, such as the mechanical-contactor type or the acoustic type, I have found that the photo-sensitive type is preferable. The preferred street devices, therefore, comprise a plurality of sources 51 and 53 of radiant energy disposed on one side of each of the highways 9 and 11 and a plurality of photo-sensitive devices 55 and 57 disposed on the other side of each of the highways in such positions as to be influenced by the radiation from the sources.

When the radiations from the light source 53 to the photo-sensitive device 57 are interrupted by vehicles moving along the highway 11 for which the "go" signals 6 are being displayed, the exciting coil 59 of relay 61, associated with the photo-sensitive device 57, is deenergized, and a circuit is completed from a direct-current bus line 63, through conductor 65, a movable contactor 67 of the relay 61 that has engaged its corresponding fixed contactors 69 by reason of the deenergized condition of the relay coil 59, conductor 71, a conducting segment 73, symmetrically disposed relative to the shaft 33 of the program control motor 35, a movable contactor 75, in engagement with the conducting segment 71 and rotated from the shaft 33, a collar 77 secured to the shaft 33, a brush 79 in engagement with the collar 77, conductor 81, the movable contactor 83 of a relay 85, conductor 87, the exciting coil 89 of another relay 91, conductors 93 and 95, a movable contact 97 of a thermostat relay 99, the fixed contactor 101 of the relay 99 and conductors 103 and 105, to the remaining direct-current terminal 107.

The relay 91, through the coil 89 of which the current is now flowing, is energized to close a circuit from one direct-current bus line 63, through a suitable resistor 109, a movable contactor 111, associated with the relay 91 that is now in engagement with its corresponding fixed contactors 113 by reason of the excitation of the relay 91, conductors 115 and 117, the windings of the program-control motor 35, conductors 119 and 121, a second movable contactor 123 of the relay 91 and conductor 125, to the remaining direct-current terminal 107.

Direct current is thus applied to the windings of the motor 35, and the speed of the motor is, consequently, decreased. The direct current through the windings of a motor is blocked from being shunted through the alternating-current source by the capacitor 49 connected in the power-supply line of the motor.

It is apparent that the length of the period during which the motor 35 is reduced in speed and also the number of times that the motor is reduced in speed depends upon the density of the traffic along the highway for which the "go" signal is being displayed. It is to be noted that the movable contactor 37, whereby the "go" signal 5 or 6 is energized for a particular highway 9 or 11, is oriented on the shaft 33 of the motor 35 in the same angular position as the contactor 75, whereby the activity of the speed-reducing device is controlled. The corresponding fixed contacts 13 and 15 and 73 and 127, which are respectively engaged by the movable contactors 37 and 75, are also similarly oriented relative to each other and, consequently, the speed of the motor is controlled only from the highway for which the "go" signal is being displayed and not from the highway for which the "stop" signal is being displayed. In the example herein set forth, the speed-control device for the motor is operated from the highway 11.

The circuit for controlling the speed of the motor 35 from the other highway 9 is closed through the contactor 129 of a relay 131 that is deenergized when the photo-sensitive device 55, associated with the highway 9, is deenergized and extends from one direct-current power line 63, through conductor 65, conductors 133 and 135, the movable contactor 129 of the relay 131, associated with the street device 55, conductor 137, the segment 127, oriented in a position corresponding to the orientation of the segment 15, whereby the "go" signal 5 is displayed for the highway 9, the movable contactor 75 when it is engaged with the segment 127, the collar 77, the brush 79 in engagement with the collar 77, conductor 81, the movable contactor 83, conductor 87, the exciting coil 89 of the relay 91, whereby the direct-current power is supplied to the motor 35, conductors 93 and 95, the movable contact 97 of the thermostat 99, the fixed contact 101, of the thermostat 99 and conductors 103 and 105, to the remaining direct-current bus line 107.

If it so happens that one of the photo-sensitive devices 55 and 57 is deenergized for an inordinately long period of time, as, for example, by a vehicle that stalls in the path of light or by the extinction of one of the light sources 51 and 53, a heating element 139 is energized. The heating element is connected in a circuit that extends from one direct-current bus line 63, through conductor 65, the conductor 133 for the photo-sensitive device 55 or the conductor 140 for the photo-sensitive device 57, the movable contactor 141, associated with the relay 131, or the movable contactor 143, associated with the relay 61, conductor 145 or conductor 147, the common conductor 149, the heating coil 139 of the thermostat 99 and the conductor 105, to the direct-current bus line 107.

When the thermostat coil 139 attains a temperature predetermined by the length of the period of time during which the photo-sensitive devices 55 or 57 remain deenergized, the movable contact 97 of the thermostat 99 is disengaged from

its fixed contact 101 and the circuit through the coil 89 of the relay 91, whereby direct current is supplied to the motor 35, is opened.

The circuit whereby the direct current is supplied to the motor 35 is, moreover, held permanently open by reason of the fact that a circuit through the exciting coil 151 of the relay 85, through the contactor 83 of which the relay 91 is energized, is opened. The circuit through the exciting coil 89 of the relay 91 now remains open in spite of the fact that the heating coil 139 may decrease in temperature to such an extent that its contacts 97 and 101 become engaged as long as the photo-sensitive devices 55 and 57 remain deenergized.

However, if the photo-sensitive devices 55 and 57 are both reenergized, the heating coil 139 is disconnected from the circuit, and the lower contactors 153 and 155 of the relays 131 and 61, associated with the photo-sensitive street devices 55 and 57, are again engaged with their fixed contacts 157 and 159. If the coil 139 of the thermostat 99 is now sufficiently cooled, a circuit is closed which extends from one direct-current bus line 63, through conductor 161, the exciting coil 151 of the relay 85, conductor 163, the movable contactor 155, conductor 165, the movable contactor 153 of the relay 131, conductors 167 and 95, the contacts 97 and 101 of the thermostat 99, and conductors 103 and 105, to the direct-current bus line 107.

The function of the relay 85, as is apparent from the above description, is to prevent the direct-current circuit through the motor 35 from being reclosed when the thermostat coil 139 is again cooled, after it has once been open, by reason of a defective condition in the system. By the arrangement set forth above, the direct current can only be supplied to the motor 35 if both of the devices 55 and 57 are energized.

In Fig. 2, a system is shown wherein the operation of the signals 1, 2, 3, 4, 5 and 6 is initiated by the coaction of a vehicle and a street device which is, in the present case, a photo-sensitive trigger. The system is particularly adapted to be utilized at the intersection 169 of a major highway 171 and a minor lane 173, as shall be explained hereinafter.

Under normal circumstances, the "caution" signals 3 and 4 are connected in a circuit extending from one alternating-current bus line 23, through conductors 175 and 177, a brush 179 in engagement with a collar 181, rotated on the shaft 33 of an inductor motor 35, whereby the program controller 183 of the system is rotated, the collar 181, a bus line 197, connecting the collar 181 and a segment 189 on an insulating disc 191 rotated by the motor 35, the segment 189, a brush 193 in engagement with the segment 189, conductor 195, the "caution" signals 3 and 4 and conductor 197 to the remaining alternating-current bus line 45.

A plurality of photo-sensitive devices 199, 201, 203 and 205 are disposed along the highway 171 and the lane 173, and a plurality of sources 207, 209, 211 and 213 are disposed opposite to the photo-sensitive devices in such manner that the light from the sources is to be interrupted by a vehicle approaching the intersection along the highway or a lane.

The motor 35, whereby the program controller 191 is actuated, is of the alternating-current induction type normally connected in a direct-current circuit that extends from one direct-current bus line 63, through conductors 215 and 217, the windings of the motor 35, conductors 219 and 221, the movable contactor 223 of a relay 225 that is in engagement with its corresponding fixed contacts 227, and conductors 229 and 231 to the remaining direct-current bus line 107.

The relay 225, whereby direct current is supplied to the motor 35, is held in energized condition by reason of the fact that its coil 257 is connected in a circuit extending from one direct-current bus line 63 through conductor 233, the movable contactor 235 of a relay 237 associated with the photo-sensitive triggers provided for the lane 173, conductor 239, the movable contactor 241 of a relay 243 that is associated with the photo-sensitive triggers provided for the highway 171, conductor 245, a conducting segment 247 disposed adjacent to the shaft 33 of the program-control motor 35, a movable contactor 249 rotated by the program control motor, a collar 251 rotated by the motor, a brush 253 in engagement with the collar 251, conductor 255, the exciting coil 257, of the relay 225, and conductors 229 and 231 to the remaining direct-current bus line 107.

If one of the beams of light transmitted across the highway 171 is interrupted, one of the photo-sensitive devices 199 and 203, associated with the highway, is deenergized, and the relay 243, associated with the photo-sensitive devices 199 and 203, is also deenergized. The circuit through the exciting coil 257 of the relay 225, whereby direct current is supplied to the motor 35, is broken, and the circuit, whereby direct current is supplied to the motor, is opened, while the second circuit, whereby alternating current is supplied to the motor, is closed.

The latter circuit extends from one alternating-current bus line 23, through a capacitor 259, the windings of the motor 35, conductor 219, a movable contactor 261, that engages a plurality of fixed contacts 263 when the relay 225, whereby direct current is supplied to the motor, is deenergized and conductor 265, to the remaining alternating-current bus line 45.

The motor 35 is now effectively energized and rotates in a clockwise direction. In rotating, it disengages the movable contactor 249, whereby the relay 225, through which the direct current was supplied to the motor, was energized, from its corresponding segment 247. The circuit then remains broken until the movable contactor 249 returns to the fixed segment 247. On the other hand, the segment 189, whereby the "caution" signals 3 and 4 were energized, is disengaged from the brush 193 and the stop signal 2, and the "go" signal 5 is, at the same time, connected in a circuit extending from one alternating-current bus line 23, through conductors 175 and 267, a brush 269 in engagement with a collar 271 secured to the shaft 33 of the motor 35, a movable contactor 273 rotated by the motor 35, a segment 275 symmetrically disposed relative to the shaft 33 of the motor 35 with which the movable contact is now engaged, conductor 277, the signals 2 and 5 and conductor 197, to the remaining alternating-current bus line 45.

A "go" signal is now displayed for the major highway 171, and a "stop" signal is displayed for the minor highway 173.

Moreover, if a second vehicle should now interrupt the beam of light associated with the major highway 171 while the "go" signal 5 is being displayed for the highway, a circuit is closed from one direct-current bus line 63, through conductors 279, 281 and 283, the lower movable contactor 285 of the relay 243, associated with the

photo-sensitive trigger, provided for the major highway 171, that is now in engagement with its fixed contacts 287 by reason of the fact that the relay 243 is deenergized, conductor 289, a fixed segment 291 symmetrically disposed relative to the shaft 33 of the motor 35, a movable contactor 293 now in engagement with the fixed segment 291, a collar 295 secured to the shaft 33 of the motor 35, a brush 297 in engagement with the collar 295, conductor 299, the exciting coil 301 of a relay 303 and conductor 305 to the remaining direct-current bus line 107.

By reason of the fact that the relay 303 is now energized, direct current is supplied to the motor 35 through a circuit extending from one direct-current bus line 63, through conductors 215 and 217, the windings of the motor 35, conductors 219 and 307, a variable resistor 309 of appropriate magnitude, conductor 311, the movable contactor 313 of the newly energized relay 303 that is now in engagement with its corresponding fixed contacts 315 and conductor 231 to the remaining direct-current bus line 107. Since the motor 35 is now partly energized by direct current and partly by alternating current, its speed is decreased, and the period of time of the display of the "go" signal 5 and the "stop" signal 2 is increased.

On the other hand, if a vehicle advancing along the minor highway 173 interrupts an exciting beam of light transmitted across that highway, while the normal "caution" signals 3 and 4 are being displayed at the intersection 169, the relay 237 is deenergized, the circuit through the exciting coil 257 is opened by the disengagement of the movable contactor 235 from its corresponding fixed contacts and the motor 35 whereby the program controller is rotated becomes energized from the alternating-current-power-supply source and remains energized by the subsequent disengagement of the movable contacts 249 from the fixed contact 247. As the program controller 183 is rotated, the movable contactor 273 engages successively its corresponding fixed contacts. Accordingly a "stop" signal 2 is first displayed for the highway 173 and a "go" signal 5 for the highway 171 and then a "go" signal 6 is displayed for the highway 173 and a stop signal 15 is displayed for the highway 171.

It is felt that, while a system such as has been described hereinabove may be disadvantageous for certain intersections by reason of the fact that the traffic along each of the highways passing through the intersections is substantially equal, to that along the other, it is particularly useful for intersections wherein the traffic along the major highway 171 is heavy, as compared with the traffic along the minor highways 173. It is highly desirable that an intersection of a highway and a lane be cleared of vehicles before the "go" signal for the lane is displayed and, since the traffic along the major highway is comparatively heavy, a considerable period of time is required for the intersection to be cleared. The period of time is occupied by the display of the "stop" signal for the lane.

It should be noted that, regardless of what system is utilized, the time of display of the "go" signal 6 for the lane 173 may be prolonged by the movement of additional vehicles along the lane after the first vehicle has passed. When the "go" signal is displayed for the lane 173, the relay 303, whereby direct current is applied to the motor, is energized by the coaction of the street device and vehicles moving along the lane 173, through the contactor 317 of the relay 237 and through the segment 319 that is in engagement with the movable contactor 293 when the "go" signal is displayed.

The apparatus shown in Fig. 3 comprises a signalling system disposed at the intersection 7 of a plurality of highways 9 and 11 along which the traffic is normally, substantially of equal density and comprising a plurality of "stop" signals 1 and 2, "caution" signals 3 and 4 and "go" signals 5 and 6.

Street devices, comprising sources of light 321 and 323 for projecting a beam across the highways 9 and 11, and photo-sensitive devices 325 and 327 on which the beams impinge, are disposed along each highway at a predetermined distance from the intersection 7.

The program controller 329, whereby the sequential display of the signals along the highway is controlled, is rotated by a direct-current motor 331, the winding 333 of which is to be connected in series with a plurality of resistor elements 335 and 337. The resistor elements are engaged by movable contactors 339 and 341 that are actuated by the one or the other of a plurality of latch relays 343 and 345, the coils 347 and 349 of which are, in turn, excited from the one or the other of the photo-sensitive triggers.

Under normal circumstances, the "stop", "caution" and "go" signals 1, 2, 3, 4, 5 and 6 are displayed in sequence for the highways 9 and 11.

As shown in Fig. 3, the motor 331 is energized through the resistor 337. The stop signals 1 and the go signals 6 are energized through the segment 350 of the program controller 329. As the elements of the program controller are rotated, the brush 352 disengages the segment 350 to deenergize the stop signals 1 and the go signals 6 and the brush 354 engages the segment 356 to energize the caution signals 3 and 4. As the elements are further rotated, the brush 354 is disengaged from its corresponding segment 356 and the caution signals 3 and 4 are deenergized and the brush 352 is engaged with another segment 358 to energize the stop signals 2 and the go signals 5. If a vehicle moving along the highway 9, for which a "stop" signal 1 is at any time being displayed, intersects the beam of light traversing the highway, the photo-sensitive device 325, provided for the highway, is deenergized, and the exciting coil 351 of a relay 353, associated with the photo-sensitive device 325, is deenergized.

A circuit is closed from one bus line 355, through conductors 357 and 359, a brush 361 associated with an interrupter 363, a segment 365 of the interrupter 363, a bus line 367 connecting the segment 365 of the interrupter to a segment 180° away from it, conductor 369, the movable contactor 373 of the relay 353, associated with the street device that has been actuated, conductor 375, the exciting coil 347 of the relay 343, whereby a ratchet 377 providing for adding resistance to the motor circuit is rotated, conductors 379 and 380, a conducting segment 381, symmetrically disposed relative to the shaft 383 of the motor 331, a movable contactor 385, rotated by the motor 331, a collar 387 secured to the shaft 383 of the motor, a brush 389 in engagement with the collar 387 and conductor 391, to the direct-current bus line 393.

It is to be noted that, while the resistance is being added to the motor circuit, the motor windings 333 are not connected to the resistor 335 that is being varied but are connected to the resistor

337 associated with the highway 11 for which the "go" signal 6 is being displayed. During the period of display of the "go" signal for the highway 11, the resistor 337 is incapable of variation by reason of the fact that the coil 349 of the latching relay 345, associated with the resistor, is disconnected from the energizing circuit, since the movable contactor 395, through which it is energized, is out of engagement with its corresponding fixed segment 397.

The motor is energized from a circuit extending from one bus line 355, through the winding 333 of the motor, conductors 399 and 401, the active section of the resistor element 337, the movable contactor 341, conductors 403 and 380, the segment 381, the movable contactor 385, the collar 387, the brush 389 and conductor 391, to the bus line 393.

The interrupter 363 is of such structure that its conducting segments 365 are long, in comparison with the insulating elements 405 by which they are separated. Under ordinary circumstances, the interrupter 363 rotates at such speed that the conducting segments 365 remain in contact with the brushes 361 during the period that would normally be occupied by several interruptions of the street device. However, if the vehicles moving along the highway for which the "stop" signal 1 or 2 is being displayed should be arranged in staggered relationship in such manner that the photo-sensitive device 325 or 327, associated with the highway, is in a deenergized condition for a considerable period of time, the interrupter will provide the necessary interruptions of the circuit, and the resistance will be added to the motor circuit as if the vehicles had been advancing separated from each other.

Finally, as is illustrated in the drawings, the interrupter 363 is directly rotated from the motor 415 whereby it is driven. In many applications of the system, the interrupter will preferably be geared to the motor in a manner predetermined by the situation under which the system is installed.

The latching systems are provided with pawls 417 and 419, whereby the ratchets 377 and 421 are held in the positions to which they are rotated against the action of springs 423 and 425 that are secured to the contactors 339 and 341. While the "go" signal 6 is being displaced for a highway 11, the motor winding 333 is connected in a circuit including the resistor 337. Preferably, several seconds before the "go" signal 6 along the highway 11 changes to a "caution" signal 4, the relay 429, controlling the position of the holding pawl 419 associated with the ratchet 421, is energized.

The energizing circuit for the relay 429 extends from a bus line 355, through conductor 431, the exciting coil 433 of the relay 429 associated with the holding pawl 419, conductor 435, a segment 437 disposed adjacent to the shaft 383 of the program-control motor 331, a movable contactor 439, now in engagement with the segment 437, a collar 441, rotated by the motor 331 and a brush 443 in engagement with the collar 411, to the bus line 393. At the same instant, the movable contactor 395, associated with the segment 397 that is connected to the coil 349 of the latching relay 345 of the ratchet 421 whereby the resistance 337 is added to the motor circuit, is rotated into engagement with the segment 397, and the vehicles advancing along the highway 11 are now counted by the latching relay 345.

It will be noted that the segments 437, whereby the latching relays are deenergized, are comparatively short. The reason for the structure is apparent since it is desirable that the vehicles be immediately counted and that as few vehicles as possible shall go through light beams without being counted.

The pawl 419 is released before the "stop" signal 2 is displayed along the highway 11 by reason of the fact that it is desirable that such vehicles as traverse the beam of light, but are obliged to wait for the "go" signal 6, shall be counted. It is to be noted that, after the contactor 341 reverts to its initial position, the movable contactor 385 remains in engagement with its corresponding segment 381. The motor is, therefore, rotated at an increased speed during the closing seconds of display of the "go" signal 6 along the highway 11. The period during which this state of affairs exists is comparatively small, and its effect on the total time of display of the "go" signal is negligible.

The counting of the vehicles along the highway 9 continues until the "caution" signals 3 and 4 are displayed and, when the signals are displayed, the segment 381 is disengaged from the contactor 385, and the speed of the motor is regulated from the resistor 335, the magnitude of which has been determined by the number of waiting vehicles. The "go" signal 5 is, therefore, displayed for a period of time determined by the number of vehicles that were awaiting along the highway 11 to pass through the intersection.

My invention has been shown herein as applied to specific systems, and many details have been shown as incorporated which may not be necessary in certain systems. However, the essential elements of my invention are clearly described herein as involving the regulation of the time of display of the "go" signal for one of a plurality of highways passing through an intersection in accordance with the density of the traffic moving along the highways.

To cover the systems in which the time of display of the signals or the speed of the contacting elements whereby the signals are controlled may be increased as well as the systems in which these properties may be decreased, I shall use the word "increment" intending that it shall apply in its mathematical sense as having either a positive polarity (in which case it connotes an increase in time or speed) or a negative polarity (in which case it connotes a decrease in these properties).

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In a traffic control system for a plurality of highways of the type incorporating a plurality of stop and go signals to be displayed for said highways, means for energizing said signals, means to be vehicle actuated, said means including photo-sensitive means and means for producing a beam of radiant energy to be intersected by vehicles moving along said highways to normally energize said photo-sensitive means and means cooperating with said energizing means and said photo-sensitive means to vary the time of display of said signals; means to respond to the number of interruptions of said beam of radiant energy by vehicular traffic and coacting with said cooperating means to control the extent to which said

cooperative means influences said energizing means thus to control the extent to which the time of display of said signals is varied and means to produce the effect of interruptions of said beam at a predetermined rate on said interruption-responsive means when said beam is continuously interrupted for a predetermined interval of time.

2. A traffic control system for a plurality of highways comprising stop and go signals to be displayed for each of said highways, a plurality of circuits for energizing said signals, a plurality of contactors of predetermined lengths connected in said circuit for closing said circuits for intervals of time proportional to the lengths, means for motivating certain of said contactors relative to certain others of said contactors to successively engage said contactors and to close the corresponding circuits thereby to provide a successive display of stop and go signals for said highways for intervals of time dependent on the lengths of said contactors, said movable contactors having normally a predetermined velocity whereby said stop and go signals are normally displayed for predetermined periods of time, means to be vehicle actuated on each of said highways and means to respond to each actuation of said vehicle-responsive means when it is vehicle actuated to vary the speed of said movable contactors in accordance with the number of actuations of said vehicle responsive means, the increment in the speed of said movable contactors increasing as the number of actuations of said vehicle-responsive means increases thereby to vary the length of the periods of display of said signals.

3. A traffic control system for a plurality of highways comprising stop and go signals to be displayed for said highways, means for energizing said signals to provide a cyclic display of stop and go signals for one of said highways and go and stop signals for another of said highways, said signals being normally displayed in a predetermined periodic sequence, means to be vehicle actuated in each of said highways and means, responsive to the number of actuations of said vehicle responsive means, when it is actuated by vehicles moving in a highway during the period of time occupied by the display of a go signal for said highway for a predetermined fraction of its period and by the subsequent stop signal for substantially the whole of its period, and cooperating with said energizing means to vary the length of the period of display of the subsequent go signal for said highways in accordance with the number of actuations of said vehicle-responsive means, the increment in the length of the period of display of said go signal increasing as the number of actuations increases.

RICHARD C. HITCHCOCK.