

2,604,525

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Pierre Laerte Dammeth,

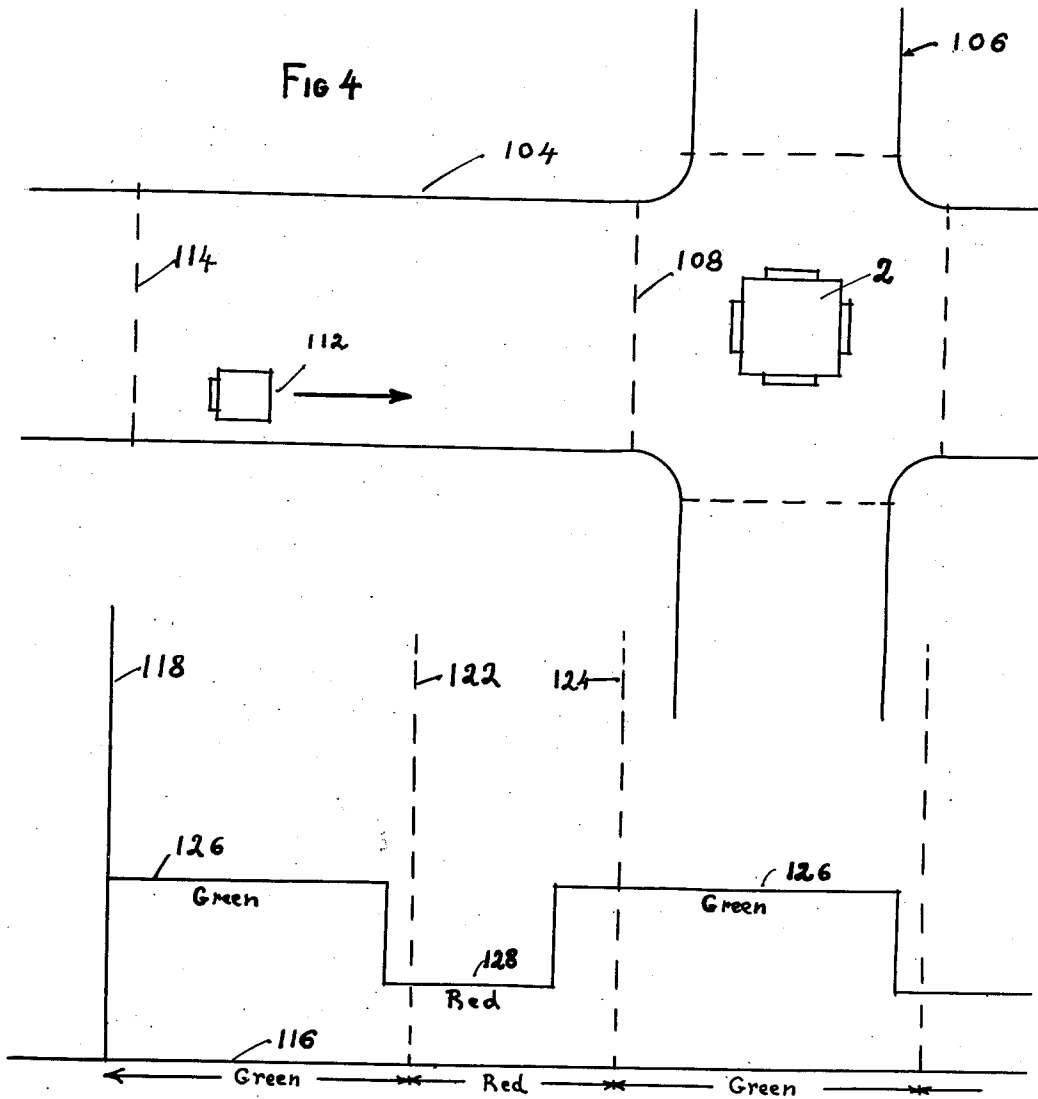
July 22, 1952

P. L. ZANNETTOS
TRAFFIC CONTROL SYSTEM

2,604,525

Filed March 28, 1949

4 Sheets-Sheet 2



INVENTOR.

Sierra Leone Zannettos

July 22, 1952

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4 Sheets-Sheet 3

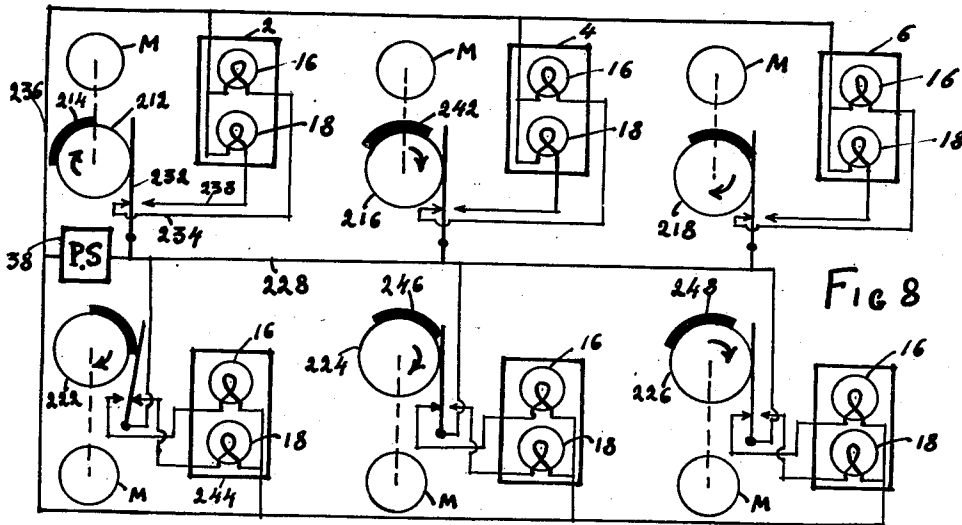
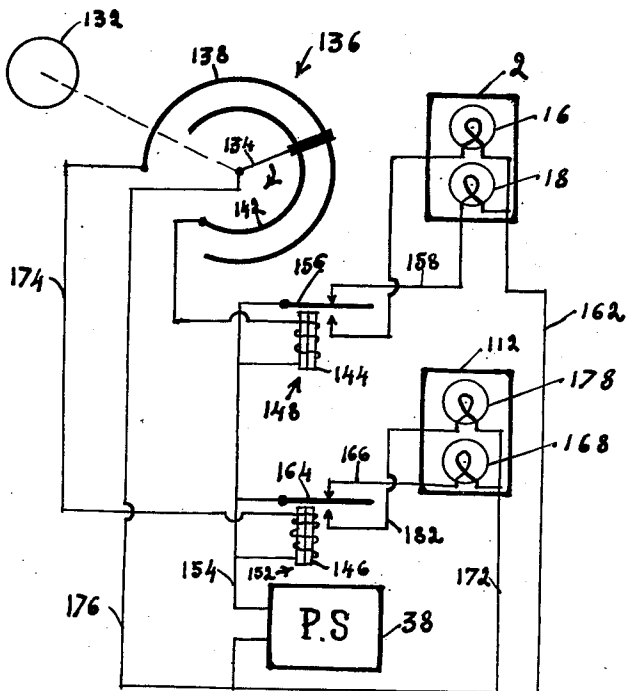


FIG 6

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TRAFFIC CONTROL SYSTEM

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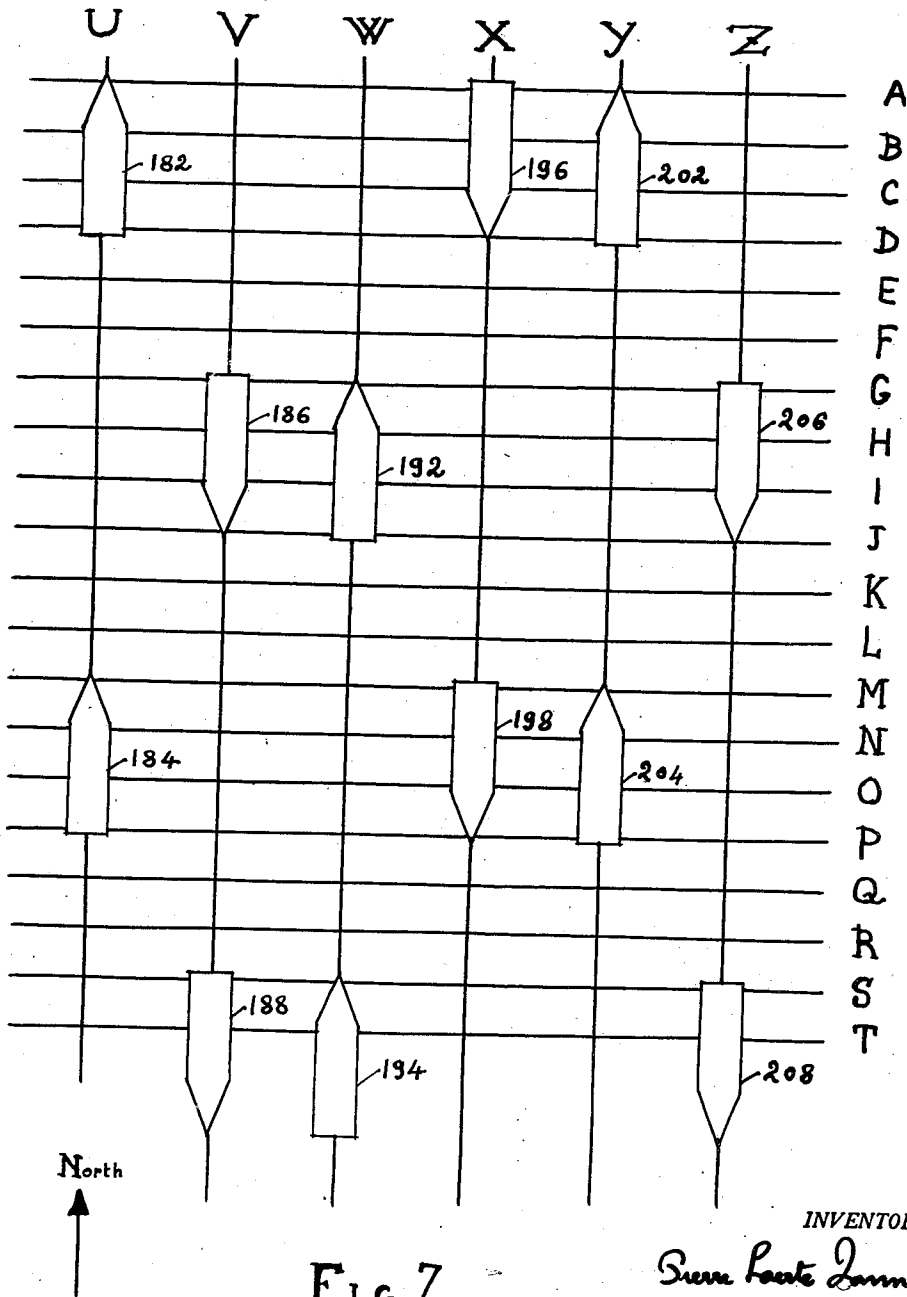


FIG. 7

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2,604,525

TRAFFIC CONTROL SYSTEM

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Application March 28, 1949, Serial No. 83,991

5 Claims. (Cl. 177-337)

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This invention relates to traffic control systems for synchronizing the flow of traffic and for regulating the movement within a progressive traffic system. More particularly it relates to traffic signals, and to apparatus, methods, and sequences of controlling such signals in predetermined time relationship, and to auxiliary signals which operate in predetermined relationship to the time cycle of synchronized or progressive traffic systems.

In order to permit rapid and convenient movement of automobile traffic in congested areas, progressive traffic systems are often employed. In such systems the red and green lights are operated in synchronized relationship along a street. The period of the cycle is usually constant, but the phase of the operating cycle of each successive light along the avenue in the direction of traffic flow is displaced in time by an amount approximately equal to the time required for an automobile to traverse the distance between the respective lights, provided it travels at the desired synchronization speed. Thus, a particular series, or "train," of successive "green" or "red" lights appears to travel continuously along the street from one end to the other. Accordingly, automobile traffic, which maintains the same progressive speed as the apparent speed of the traffic lights, can move without interruption along the street.

Such progressive systems are well known and have improved the movement of traffic, but, in practice, have not operated with complete satisfaction for several reasons. In the first place, no simple method has been provided to indicate to the motorist whether he is in the leading, middle, or trailing portion of the green "train" within which he is traveling. Thus, a driver has no means for either gaging or correcting his speed relative to the progressive movements of the lights, until he is stopped by a red light. The present invention provides, among other things, for a continual indication of the relative position of an automobile within the green "train", so that a driver, if he finds himself in the trailing part of the green "train", may increase his speed slightly, and, if he finds himself in the leading part of the train, decrease his speed slightly, thus, in either case applying corrective measures without being forced to stop at red light. In addition, this indication is provided in such manner that it can be readily interpreted by the average motorist.

Another difficulty with progressive systems is that interference is caused by unsynchronized traffic along the street. For example, traffic which enters the street from a side street and is forced to stop at the next intersection. If the full portion of the subsequent green "train" is being utilized to carry traffic, the cars in the lead-

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ing portion of the train will be forced to slow down by the cars which had stopped for the light and are accelerating to gain synchronization speed. Similar interference is caused by other vehicles that do not travel continuously along the street, for example, passenger buses, which cannot maintain the required synchronization speed because of the necessity for stopping to pick up and discharge passengers.

The present invention provides for secondary or check-point traffic indicators, having the same over-all cyclic period as the progressive system, but which are displaced in time and physical position from the nearest lights of the progressive system. These secondary lights control the unsynchronized traffic so that it causes the least interference with the synchronized traffic.

Another difficulty is that progressive traffic systems are often established along certain thoroughfares, but with no provision for the progressive movement of cross traffic. The present invention includes provision for the synchronized movement of traffic traveling in perpendicular or oblique directions. Moreover, the system is arranged to increase the available parking space, without appreciably reducing the total traffic movement.

Accordingly, the present invention provides methods and apparatus for increasing and smoothing the flow of traffic. One aspect of the invention relates to secondary or check-point indicators which have the same total period as the indicators of the progressive system, but which are displaced in phase, i. e. time, therefrom. Such secondary indicators have a total period equal to the period of the progressive system, but the proportions of time allotted to the green and red is different from that of the progressive cycle, and in one embodiment the red portion is reduced and the green portion is increased, and the light is arranged to have an effective control position in leading relationship to one of the traffic indicators of the progressive system, thereby to regulate the movement of unsynchronized traffic.

In another aspect, the invention provides a traffic signal having the usual indicator lights and in addition an auxiliary indication for denoting the portion of the green part of the cycle which has elapsed. Thus, the invention provides for the continuous and smooth movement of traffic, and for the simultaneous movement of synchronized traffic in four or more directions.

For example, in accordance with one embodiment of the invention, the traffic is regulated in such a manner that traffic proceeding parallel to a first direction can proceed progressively on adjacent one-way avenues, and that cross traffic simultaneously proceeding parallel to a second direction may do so progressively and continuously on predetermined cross-drives,

Other objects and advantages of the present invention will be apparent from a consideration of the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 shows a series of successive traffic lights having auxiliary indicators; this drawing shows the relationship between these successive lights at one particular instant;

Fig. 2 represents graphically the cyclic operation of the traffic and auxiliary lights shown in Fig. 1;

Fig. 3 illustrates, diagrammatically, apparatus for operating the traffic control system of Fig. 1;

Fig. 4 represents, diagrammatically, an intersection in a progressive traffic system with a secondary or check-point traffic indicator; displaced in phase and position, for controlling unsynchronized traffic;

Fig. 5 represents, graphically, the operation of the traffic and secondary indicator of Fig. 4;

Fig. 6 shows, diagrammatically, apparatus for controlling the traffic lights shown in Fig. 4;

Fig. 7 illustrates the arrangement and operating sequence of a group of traffic lights in order to obtain the advantages of complete traffic synchronization; and

Fig. 8 shows, diagrammatically, apparatus for operating the traffic lights of Fig. 7.

In order to more fully explain the position and operation of the traffic control lights, we may consider the progressive lights as forming luminous waves that travel along the respective avenues or streets, and in which the leading part of the wave is represented by the foremost red "stop" signal facing the direction the wave is moving. The red portion of the wave is termed the "red train"; the green portion is termed the "green train." Thus, the red and green trains move continuously along the length of the thoroughfare, their lengths depending upon the proportion of red and green lights utilized in the progressive system.

The wave-length of the luminous waves may be taken as the distance between the leading points of successive red trains on a given avenue, and may be measured by the number of street intersections over which the wave extends, or they may be measured in terms of standard blocks or other convenient units.

In order to regulate his progress in a progressive traffic system, a driver is not so much concerned with the exact synchronization speed of the system (a speed which, in any case, he cannot maintain precisely) as with a knowledge of whether he should increase, decrease, or hold constant his present speed. For example, if the driver can know at all times the distance between himself and the nearest red light ahead, he can adjust his speed at each intersection and travel indefinitely without being caused to stop by the lights of the progressive system.

A traffic light 2 (Fig. 1) provides such an indication. In order to understand its operation, assume that light 2 and similar lights 4, 6, 8, 10, 12, and 14 are placed at successive intersections along a street and that green indicator 16 and red indicator 18 are operated so as to form a progressive traffic system along the street. In this example, there are three green lights in each green train and two red lights in each red train. Thus, if the entire period of the cycle is 75 seconds, each green lamp 16 will be illuminated (indicated in Fig. 1 by the cross-hatching) for 45 seconds (three-fifths of 75), at which time the green light will be extinguished and the red lamp

18 illuminated for 30 seconds. Each of the traffic lights 2 to 14 operate in this manner, but the operation of successive traffic lights is displaced in time by 15 seconds so that traffic can move continuously along the street provided it maintains an average speed such that it travels from light to light in 15 seconds. This part of my system is conventional and is well known.

In order to enable the driver to regulate his speed to maintain the desired average, three auxiliary indicators 22, 24, and 26 are provided in conjunction with each of the lights. These indicators are connected into the circuits which operate indicators 16 and 18, and by mechanism of well known types, are caused to operate in the following manner:

The number of auxiliary indicators illuminated denotes the distance, for example, the number of blocks or street intersections, to the next red light ahead of the driver. For example, in Fig. 1, indicator 22 only of traffic light 2 is illuminated (note cross-hatching), denoting that a red light is illuminated one block ahead, as shown by indicator 18 of traffic light 4. None of the auxiliary indicators 22, 24, or 26 are illuminated in traffic lights 4 or 6, because the red indicators 18 are illuminated.

At the instant of time under consideration, green indicator 16 of traffic light 2 has just been illuminated, the three illuminated auxiliary indicators 22, 24, and 26 informing the drivers at this intersection that the next red light is three blocks ahead and that, accordingly, they must maintain or increase, but not decrease, their speed.

At the next intersection, auxiliary indicators 22 and 24, of light 10, are illuminated indicating that the next red light is two blocks ahead (at light 14). The drivers at this intersection are advised thereby to maintain substantially the same driving speed. In a similar manner, those drivers observing the single illuminated auxiliary indicator 22 of traffic light 12 are advised thereby to decrease or hold constant, but not to increase, their speed.

Fig. 2 shows the cyclic operation of the auxiliary indicators 22, 24, and 26 of one of the traffic lights, for example, traffic light 2, with respect to the cycle of operation of indicators 16 and 18. Line 27 is a time axis, and green indicator 16 is illuminated during the time corresponding to the horizontal distance between lines 29 and 30. At this time the green is extinguished and red indicator 18 is illuminated for the period of time represented between lines 30 and 31.

The auxiliary indicators 22, 24, and 26 indicate, in effect, the time remaining before the end of the green period. Thus, line 28, extending from line 29 to line 32 and indicates that all three auxiliary indicators are illuminated; line 33 extending from line 32 to line 34, indicates that two of the auxiliary indicators are illuminated; and line 35, extending from line 34 to 36 (corresponding to the end of the green period at line 30) indicates that only one of the auxiliary indicators is illuminated.

It is to be understood that the number of auxiliary indicators to be employed will depend upon the particular traffic system and that the greater the number of indicators, the nearer the lines 28, 33, and 35 will assume the form of line 37, which denotes continuous indication.

Fig. 3 shows schematically an arrangement for operating the traffic light 2 with the auxiliary indicators 22, 24, and 26. One terminal of a

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source of power 38 (not shown) is connected by a lead 39 to one terminal of each of the lamps which illuminate indicators 16 and 18. This terminal is connected also by a lead 42 to a rotor arm 44 of a selector switch, generally indicated at 46. Arm 44 rotates continuously in a clockwise direction and during three-fifths of each revolution (in this particular example makes contact with a switch segment 48, which is connected to one terminal of an actuating coil 52 of a relay 54; the opposite terminal of coil 52 is connected to power source 38 through a lead 56. Thus, when rotor arm 44 is in contact with segment 48, coil 52 is energized, relay arm 58 is moved downwardly to close contacts connecting lead 56 from power source 38, through lead 62, and arm 58 to lead 64. Lead 64 is connected to the lamp which illuminates green indicator 16, thus, illuminating the green whenever rotor arm 44 is in contact with segment 48. During the remaining portion of the cycle, relay 54 is in the open position, thus connecting power lead 56 through lead 62, relay arm 58 and lead 66 to the lamp which illuminates the red indicator 18.

The power lead 56 is connected also through lead 68 to one terminal of the lamp which illuminates auxiliary indicator 22, which is connected in series with the lamps associated with indicators 24 and 26; the opposite terminal of the lamp of indicator 26 being connected by a lead 72 to a segment 74 of switch 46. Thus, during the first one-third of the green portion of the cycle, all three of the auxiliary indicators are illuminated.

During the second one-third of the green period, arm 44 makes contact with a switch segment 76, which is connected by a lead 78 and a resistor 82 to cause illumination of auxiliary indicators 22 and 24. During the last one-third of the green period, the switch arm 44 makes contact with a switch segment 84 which is connected through a lead 86 and a resistor 88 to cause illumination of indicator 22. During the red portion of the cycle all auxiliary indicators are extinguished because rotor arm 44 does not make contact with any of the segments.

It is to be understood that the circuit and apparatus for actuating the auxiliary indicators are of conventional type and commercial equipment can be modified readily to perform the desired functions. The other traffic lights along the street can be actuated by similar switching arrangements in which the rotor arms will be synchronized with arm 44, but will assume various rotational positions (as at 94, 96, 98, and 102) relative to arm 44, depending upon their respective locations along the street.

The above portion of the system provides an advantageous arrangement for the traffic that is moving continuously along a thoroughfare, but makes no provision for preventing traffic that is unsynchronized, or which enters the thoroughfare from a side street, from interfering with the free flow of traffic. In order to overcome this difficulty, and in particular to provide a convenient control system for public conveyance vehicles such as buses and the like, a secondary traffic indicator is positioned ahead of each intersection as shown in Fig. 4.

A traffic light, such as that shown at 2 in Fig. 1, is positioned in the usual manner at the intersection of a street 104, which carries the progressive traffic, and a cross street 106. Traffic which is traveling progressively along this street 104, in the direction of the arrow, is controlled by

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traffic light 2, with which a "stop line" 108 is associated. However, traffic entering this street from the preceding intersection, or unsynchronized traffic such as buses, are controlled by a secondary traffic light 112 which is equipped with the usual red and green indicators. A "stop line" 114 is associated with this traffic light. The entire cycle of operation of secondary light 112 occupies the same length of time as the main traffic light 2, but is displaced in time therefrom, and the green portion of the cycle occupies a larger proportion of the total period than it does in the main traffic light 2. Thus, the secondary traffic light provides a red indication a short interval of time preceding the instant when the main traffic light 2 turns from green to red. Advantageously, this difference in time is equal to or a little longer than the time that it would take for traffic, traveling at the synchronization speed of the progressive system, to pass from "stop line" 114 to "stop line" 108. Thus, traffic which is not sure to pass traffic light 2 while the green indicator is illuminated will be stopped by secondary light 112 at "stop line" 114.

The secondary traffic light 112 changes from red to green before the corresponding change occurs at traffic light 2, and this period of time is such as to permit traffic which starts from a stationary position at line 114 to reach line 108 substantially at the time traffic light 2 changes from red to green. This accelerating traffic, of course, requires more time to traverse the distance from line 114 to line 108 than for the synchronized traffic and therefore the time difference between the auxiliary light 112 and traffic light 2 is greater in this instance.

Fig. 5 illustrates the sequence of operation of secondary light 112 with respect to its associated traffic light 2. The base line 116 represents a time axis, and the distance between vertical lines 118 and 122 represents that interval during which traffic light 2 is green, and the interval between lines 122 and 124 represents the time during which traffic light 2 is red, the cycle repeating itself in the usual manner. The horizontal line 126 indicates the interval during which auxiliary light 112 is green, and line 128 indicates the interval during which it is red. It is apparent that light 112 changes from green to red a short interval of time before the corresponding change in traffic light 2. At the time represented by the right-hand end of line 128, secondary light 112 changes from red to green, and it is apparent also that this change occurs at an interval of time preceding the corresponding change in traffic light 2, and that the interval in the latter instance is longer than in the first, thereby to allow for the accelerating traffic as explained above.

Fig. 6 represents, diagrammatically, the apparatus for controlling the secondary traffic light 112 in conjunction with traffic light 2. A motor 132 is arranged to rotate a rotor arm 134 of a selector switch, generally indicated at 136, continuously in a clockwise direction. Rotor arm 134 is arranged to make contact with a switch segment 138 during a portion of its cycle of rotation and with segment 142 during a different portion of its rotation. The inner segment 142 is utilized to control the illumination of traffic light 2 and the outer segment 138 controls the illumination of secondary traffic light 112.

Starting with rotor arm 134 positioned so that it does not make contact with either segment 138 or 142, actuating coils 144 and 146 of relays 148 and 152, respectively, are both de-energized. At

this instant of time, power supply 38 is connected through lead 154 to armature 156 of relay 148, and through lead 158 to the red lamp 18 of the main traffic light 2. The opposite terminal of this lamp is connected through lead 162 to the power supply 38.

Lead 154 is also connected through armature 164 of relay 152 and lead 166 to the red indicator lamp 168 of auxiliary traffic light 112. The opposite terminal of this lamp is connected through a lead 172 to power supply 38. Thus, both relays are de-energized and both traffic lights exhibit a red indication.

As the rotor arm 134 moves clockwise, it first engages switch segment 138 which energizes coil 146 of relay 152 through a circuit which may be traced as follows: power supply 38, lead 154, relay coil 146, lead 174, rotor arm 134, switch segment 138, and lead 176 to the opposite terminal of power supply 38. Armature 164 of relay 152 thereby is caused to move to its lower position extinguishing red indicator lamp 168 of auxiliary traffic light 112, and energizing green indicator lamp 178 through leads 182 and 172. Thus, during this interval traffic light 112 gives a green indication and traffic light 2 continues to exhibit the red indication.

As the rotor arm 134 continues to move in a clockwise direction, it additionally makes contact with switch segment 142, which energizes coil 144 of relay 148 to extinguish red indicator lamp 18 and energize the green indicator lamp 16 of the main traffic light 2. Thus, during that portion of the rotation of rotor arm 134 when it makes contact with both segments 138 and 142, traffic lights 2 and 12 exhibit a green indication.

Further rotation of rotor arm 134 breaks the connection between the rotor arm 134 and switch segment 138, de-energizing relay 152 and changing secondary traffic light 112 from a green to a red indication, the main traffic light 2 continuing its green indication for a short interval of time until rotor arm 134 no longer makes contact with segment 142, when both lights again exhibit the red indication. This cycle repeats in synchronism with the remainder of the progressive system.

It is apparent that the switch segments shown in Fig. 3, which control the auxiliary lights 22, 24, and 26 of the main traffic light 2, can readily be embodied in the switch 136, but have not been shown in this figure in order to simplify the drawing.

In the above discussion, we have not taken into account the movement of cross traffic, but have considered only the progressive movement of traffic along a single thoroughfare. In order to synchronize the flow of traffic along a series of avenues and streets situated perpendicular or oblique to each other, I have arranged for the parallel avenues to carry one-way traffic with adjacent avenues carrying traffic in opposite directions. Moreover, I have arranged the system so that only certain of the cross streets will carry progressively moving one-way traffic.

In order to further illustrate this system of traffic control, consider the example shown in Fig. 7. Traffic lanes U, V, W, X, Y, and Z represent north-south avenues, the traffic on adjacent avenues traveling in opposite directions, for example, traffic on avenue U travels north, on avenue V it travels south, on avenue W it travels north, etc. This traffic on the north-south avenues is progressive so that the traffic can move continuously on each of these streets, provided

it maintains an average speed within predetermined synchronization limits. The cross streets, A, B, C, D, E, F—Q, R, S, and T are available to carry the necessary cross traffic. In this example, every third street, that is A, D, G, J, M, P, and S are termed cross-drives, and carry one-way synchronized cross traffic, the direction of travel on adjacent cross-drives being opposed, as, for example, cross-drives A, G, M, and S are arranged to carry traffic from west to east, whereas traffic on cross-drives D, J, and P moves from east to west. The traffic on each cross-drive moves continuously without interruption.

The intervening cross streets, for example, B, C, E, F, H, I, etc. do not carry synchronized traffic, and are utilized in the manner best suited for the particular traffic problem. For example, they may be closed to through-traffic and utilized for parking space, loading and unloading operations, etc., or they may be opened to through-traffic in one direction or in both directions.

As was explained above, the traffic lights, along the avenues, may be considered as luminous waves that travel along the respective avenues and the leading part of the wave may be considered as represented by the first red signal facing the approaching traffic on the avenue. The red trains on the avenues are shown in Fig. 7 at 182, 184, 186, 188, 192, 194, 196, 198, 202, 204, 206, and 208. Thus, the red trains (the intervening space representing the green portion of the trains) move continuously along the one-way north-south avenues, the length of the red trains, as represented in Fig. 7, depending upon the proportion of red and green lights utilized in the progressive system. Thus, red train 186, in the particular position shown, would stop any unsynchronized south bound traffic on avenue V at the intersections with streets H and I and the cross-drives G and J, whereas east-west traffic on these cross streets and cross-drives G, H, I, and J would be permitted to move across avenue V at that instant.

For convenience in this example, we can define "n" in such manner that $4/n$ is equal to the number of intersections included in one complete cycle, or wave of lights on the north-south avenues.

We can further specify that the synchronization speed on the cross-drives is adjusted so that the time required to travel from a given intersection to the next intersection on the cross-drive is equal to the time required to travel on the avenue from the n th preceding intersection to the intersection with said cross-drive. In other words, in the present example, n is given a value of three and the progressive traffic speed on, say, cross-drive M is related to the synchronization speed on avenue V so that as a car moves from avenue U to avenue V on drive M, a particular point on the luminous wave on avenue V will have advanced from cross-drive J to cross-drive M. Thus, the choice of synchronization speeds will depend upon the length of the blocks on both the avenues and streets.

The system may be set up for various values of "n" depending upon the volume of cross traffic, and the number of drives required to handle this traffic. There will be one cross-drive for every "n" cross street. For example, if "n" is made equal to two, every other cross street may carry synchronized one-way cross traffic; if "n" is made equal to three (as in Fig. 7), then every third cross street may carry one-way synchronized cross traffic. As the value of "n" is increased, the number of cross-drives is diminished, but the

duration of the crossing time at the avenues can be increased correspondingly. This arrangement allows a longer crossing time and because of the two-way synchronization increases the effectiveness of the crossing time.

In the example given, synchronization of the cross-drive traffic can be seen readily by following an imaginary vehicle from west to east along cross-drive M. The vehicle crosses avenue U as the leading portion of red train 184 reaches the cross-drive M, causing the west-east traffic lights to exhibit the green or "go" indication. This is at a time when traffic and signals on all of the avenues will have the positions shown in Fig. 7.

During the time the vehicle is advancing along drive M from avenue U to avenue V, the traffic light indications will have progressed three blocks on the avenues; thus, red train 186 will have moved three blocks to the south (from the position shown) and will reach drive M simultaneously with the vehicle, permitting it to cross avenue V without stopping.

During the time the vehicle is advancing from avenue V to avenue W, the red trains will advance three more intersections on the avenues. Thus, red train 194 will have advanced a total of six blocks from the positions shown and will reach drive M simultaneously with the east-bound vehicle, which may then cross avenue W without changing speed.

During the time the vehicle progresses along cross-drive M from avenue W to avenue X, the red trains on the avenues will have progressed another three blocks, making a total of nine blocks from the positions shown in Fig. 7. Thus, red train 196 will reach cross-drive M at the same instant as the vehicle, permitting it to continue at a steady speed across avenue X.

During the time the vehicle progresses across drive M from avenue X to avenue Y, the red trains on the avenues will move an additional three blocks in their respective directions. The traffic lights thus will have advanced twelve blocks from their initial positions shown in Fig. 7, and, in this example, will have completed one full cycle. Thus, the vehicle will reach avenue Y simultaneously with a red train on the avenue. The path of the vehicle may be traced, in a similar manner, the remainder of the distance across drive M, and also along the cross-drives A, D, G, J, P, and S in the indicated directions.

It is to be understood that traffic systems are by their nature subject to considerable variation in order to comply with the invariable constants of a particular area in which the system is to be installed. For example, it is not always possible to locate the cross-drives at exactly modular distances. Some leeway is permissible, depending upon the ratio of red to green lights along the avenues and upon the cyclic constants of the system. If greater variation is necessary, the synchronization speed may be varied along each avenue as required.

Although, in the system illustrated in Fig. 7, the cross-drives and avenues have been shown in perpendicular relationship, one or more of the streets may be oblique, the synchronization system still being applicable under the principles outlined herein. It is also to be noted that streets intervening between the cross-drives may be closed to through traffic, as pointed out above, it follows then that they may be also non-existent or irregularly spaced. It is apparent also that the concepts of distance and travel time are

largely interchangeable in a discussion of traffic systems; thus, variations in distance may be compensated by corresponding changes in synchronization speeds.

Fig. 8 illustrates diagrammatically a mechanism for operating the traffic lights in this traffic system. The red and green lights are controlled at each intersection by a continuously rotating cam such as that shown at 212 which is provided with a raised portion 214. This cam, for example, is used to control traffic light 2 which may be considered to be positioned at the intersection of avenue U and cross-drive J in Fig. 7. Cams 216 and 218 control the traffic lights at the intersections of avenue U with cross streets K and L, respectively, and cams 222, 224, and 226 control the traffic lights at the intersections of the same streets with avenue V. Motors M are arranged to be driven in synchronism, for example, by the use of synchronously rotating motors operated from a common alternating current supply (not shown).

The traffic lights shown in Fig. 8 are assumed to be those facing the traffic along the avenues U and V at the above intersections, and it is, of course, understood that the same switch arrangements can be used to control the complementary traffic lights that regulate traffic movement along the cross streets and the cross-drives. For example, the red lights on the cross streets are merely connected in parallel with the green lights facing the avenue.

The raised cam portion 214 of cam 212 controls the red indicator lamp 18 of traffic light 2 and occupies one-fourth of the circumference of the cam 212, because, in this particular example, the red indicator 18 is illuminated during one-fourth of the control cycle. The rate of rotation of the cam 212 is proportional to the desired progressive speed of the traffic. Thus, one rotation of the cam 212 will correspond to a movement of the luminous wave through twelve intersections on the avenues.

The position of cam 212 as shown in Fig. 8 corresponds to the traffic control condition at the intersection of avenue U and cross-drive J on Fig. 7. The green indicator being illuminated through a circuit that may be traced from power supply 38 through lead 228, switch arm 232, and lead 234, to one terminal of lamp 16, the opposite terminal being returned to power supply 38 through lead 236. It will be noted that the nearest approaching red train 184 on avenue U is three blocks away, corresponding to one-fourth of a revolution of cam 212. Thus, lamp 16 will remain illuminated until the raised cam portion 214 strikes switch arm 232, the outward movement of which disconnects the green lamp 16 from the power supply 38 and connects red indicator lamp 18 to the power supply through lead 238, switch arm 232, and lead 228. The raised portion of the cam will cause the red indication to be exhibited for a period of time corresponding to the movement of the luminous wave three blocks along the avenue, at which time the indication will change from red to green, to continue the cycle.

Cam 216, having a raised portion 242, controls traffic light 4 situated at the intersection of avenue U and cross street K in exactly the same manner, except that the raised portion 242 is displaced 30 degrees clockwise, relative to cam 214. Thus, as shown in Fig. 7, red train 184 has only two blocks to travel before reaching this intersection. The cam 218 which controls traf-

fic light 6 at the intersection of avenue U and cross street L, is displaced an additional 30 degrees in a clockwise direction because red train 184 will travel only one block before reaching cross street L. It is apparent that remaining traffic lights along avenue U will be controlled in a similar manner, each associated cam being displaced 30 degrees from the ones associated with adjacent traffic lights.

It will be apparent that, irrespective of the number of traffic lights along avenue U, so long as they are evenly spaced, there will be only twelve positions, in this particular example, that are occupied by the cams simultaneously. Thus, it is apparent that twelve cams can be used to control all of the traffic lights along the avenue, and that these may be located at a central control point with appropriate leads extending to the particular traffic lights. Many other timing arrangements are known and may be readily employed, provided the synchronization is maintained in accordance with the principles outlined herein.

Cam 222 controls the traffic at the intersection of avenue V and cross-drive J and is displaced 90 degrees in a clockwise direction from the cam 212 and in the position shown has just caused the red indicator 18 of traffic light 244 to be illuminated, corresponding to the condition shown in Fig. 7 wherein red train 186 has just entered the intersection with cross-drive J. Cams 224 and 226, which control the traffic at intersections K and L, respectively, with this same avenue, function in the same manner but have the raised cam portions 246 and 248 displaced 30 and 60 degrees, respectively, in a counter-clockwise direction from that of cam 222, in order to control the movement of traffic in a direction opposed to that along avenue U.

In Fig. 8, electrical connections are not shown for the auxiliary indicators 22, 24, and 26, nor for the secondary traffic light 412, in order to simplify the drawing, but it is readily seen that such connections can be easily incorporated, for example, by utilizing separate cams mounted to rotate synchronously with the cams controlling the main traffic lights.

Thus, the entire traffic system (1) provides a highly desirable arrangement in which provision is made for keeping the progressively moving traffic in synchronism to avoid unnecessary stops with the attendant delay in traffic movement, (2) provides auxiliary indicators for co-ordinating unsynchronized traffic with the progressively moving traffic with the least interference, and (3) provides for the synchronized movement of traffic along streets perpendicular to each other, with greater effective crossing time on the drives. In addition, the arrangement of the system is such that in many instances, the synchronization of the cross traffic results in such increased efficiency that the synchronized cross-drives can successfully carry more traffic than all of the cross streets under unsynchronized conditions. Thus, this arrangement has the important advantage in congested areas of permitting the use of unsynchronized cross streets for additional parking space and loading and unloading operations without hampering the movement of traffic on the main arteries. It is apparent that the basic system described herein will need to be modified in accordance with the particular requirements of each traffic problem, and it is, accordingly, apparent that the examples given are not intended to be exhaustive or limiting of the in-

vention, but are provided for the purpose of illustration in order that others skilled in the art can fully understand the invention and the principles thereof, and the manner of applying it in practical use so that they can best modify and adapt it in its various forms, each as may be best suited to the conditions of the particular use. It is further apparent that various features of the present traffic system can often be used to advantage without a corresponding use of other features. This application is a continuation-in-part of my earlier application Serial No. 721,138, filed January 9, 1947, now abandoned.

I claim:

1. A traffic control system comprising a first plurality of one-way progressive traffic systems having a plurality of intersections, a series of primary traffic indicators having "stop" and "go" indications and positioned along a first series of adjacent substantially parallel streets at said intersections, the direction of progressive traffic movement on alternate streets being in one direction and on intervening streets in the opposite direction; a second plurality of non-stop traffic systems having a series of primary traffic indicators having "stop" and "go" indications and positioned along a second series of streets intersecting said first series of streets, the direction of traffic movement on adjacent streets of said second series being in opposite directions; a third series of streets substantially parallel with said second series of streets and having at least one street thereof positioned between each pair of adjacent streets of said second series, a plurality of secondary traffic indicators having "stop" and "go" indications each positioned along the streets of said first series of streets intermediate said intersections and associated with but spaced ahead of one of said primary traffic indicators in a direction toward the approaching traffic and facing the approaching traffic, means for operating said secondary indicators with the same length of cycle as its associated primary indicator and with a different proportion of time for "stop" and "go" indications, and a plurality of auxiliary indicators each associated with one of said primary traffic indicators, and means operating said auxiliary indicators to denote the unexpired portion of the "go" portion of the cycle of its associated primary traffic indicator.

2. In a traffic control system, the combination comprising a first series of traffic lights positioned at intersections along an automobile traffic-way to form a progressive traffic control system, a secondary traffic indicator associated with one of said traffic lights and having "go" and "stop" indications facing the oncoming traffic and positioned intermediate two of said intersections and spaced along said traffic-way a predetermined distance ahead of said one of said traffic lights of said progressive system in a direction toward the approaching traffic, switch means for controlling said "go" and "stop" indications of said secondary indicator in predetermined synchronized relationship with said last-said traffic light, said last-said means being arranged to energize said "go" indication for a larger proportion of each cycle of operation than is the "go" indication of said adjacent traffic light.

3. A master traffic control system for use in an area in which a first series of substantially parallel main streets are intersected by a second series of substantially parallel subordinate

streets, said master traffic control system comprising progressive traffic control systems along each of the main streets of said first series arranged to permit only one-way progressive traffic thereon, said systems being arranged to permit one-way traffic in opposite directions along adjacent main streets, each of said progressive traffic control systems including a plurality of primary traffic control indicators spaced along said main streets at said intersections and having "stop" and "go" indications, each of said progressive control systems including a plurality of secondary traffic control indicators having "go" and "stop" indications, each of said secondary indicators being positioned intermediate said intersections and associated with a primary indicator and spaced ahead of its associated primary indicator along a main street in a direction opposite to that of the progressive one-way traffic thereon and facing the progressive traffic thereon, and switch means arranged to regulate the indications of the primary and secondary indicators and to change the indications of the primary and secondary indicators through repetitive cycles of a predetermined length for each cycle, the cycles of each of the secondary indicators being of the same length as the cycles of the primary indicators associated therewith, the respective cycles of each of said secondary indicators commencing at a time different from that at which the respective cycles of each of the associated primary indicators commence, said cycles of each said secondary indicators having a longer length of time of "go" indication than the length of time of the "go" indication of the associated primary indicators.

4. In a traffic control system, the combination comprising a first series of primary traffic lights positioned at intersections along an automobile traffic-way to form a progressive traffic control system, said primary traffic lights having at least two traffic regulating indications, one of said indications being a "go" indication and one being a "stop" indication, first switch means for cyclically changing the indications of each of these primary traffic lights, a control mechanism operatively connected to said mechanisms arranged to maintain a predetermined synchronizing relationship thereamong, a secondary traffic-light associated with and positioned intermediate said intersections and spaced along said traffic-way a predetermined distance ahead of one of said primary traffic lights of said progressive system in a direction toward the approaching traffic and having "go" and "stop" indications facing said approaching traffic, and second switch means arranged to control said secondary traffic-light through cycles equal in duration to the cycles of said associated primary traffic light in predetermined time relationship therewith and including means for actuating the "go" indication of said secondary-light for a larger proportion of each cycle of operation of the secondary light than is the "go" indication of said associated primary traffic light, whereby automobiles which have been stopped by said secondary light can accelerate before the associated succeeding primary light begins a "go" indication.

5. A master traffic-control system comprising a first series of adjacent substantially parallel streets, a plurality of intersections, a first plurality of one-way progressive traffic systems

each having a series of primary traffic indicators and being positioned along one of said streets at said intersections, said systems being arranged to permit progressive traffic movement along the streets of said first series only in opposite directions on adjacent streets, a second series of streets intersecting said first series of streets, a second plurality of non-stop traffic systems having a series of primary traffic indicators positioned along said streets of said second series and being arranged to permit non-stop traffic movement on adjacent streets of said second series only in opposite directions on adjacent streets thereof, said primary traffic indicators having at least two indications, one of said indications being a "go" indication, and another of said indications being a "stop" indication, a third series of streets substantially parallel with said second series of streets and having at least one street thereof positioned between each pair of adjacent streets of said second series, a plurality of secondary traffic indicators each associated with but spaced ahead of one of said primary traffic indicators, said secondary traffic indicators being positioned intermediate said intersections and spaced from the associated primary traffic indicators along the streets of said first series in a direction opposite to that in which said progressive traffic movement occurs, each of said secondary indicators having at least two indications facing the progressive traffic, one of said indications being a "go" and another of said indications being a "stop" indication, switch means arranged to change the indications of each of the primary traffic indicators positioned along said first series of streets through repetitive time cycles of predetermined length and arranged to change indications of said secondary indicators through repetitive cycles, the cycle of each secondary indicator being of the same length as the cycle of the primary indicator associated therewith, said switch means being arranged to commence the cycles of each of said secondary indicators at a time earlier than that at which the cycles of its associated primary indicators commence, said cycles of each of said secondary indicators having a longer length of time of "go" indication than the length of time of the "go" indication of the associated primary indicator, and a master control mechanism arranged to control said switch means to establish a predetermined time relationship among the indications of said progressive control mechanisms whereby constant-speed one-way non-stop traffic movement is permitted on the streets of both said first series and said second series and whereby two-way non-progressive traffic movement is permitted along the streets of said third series.

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