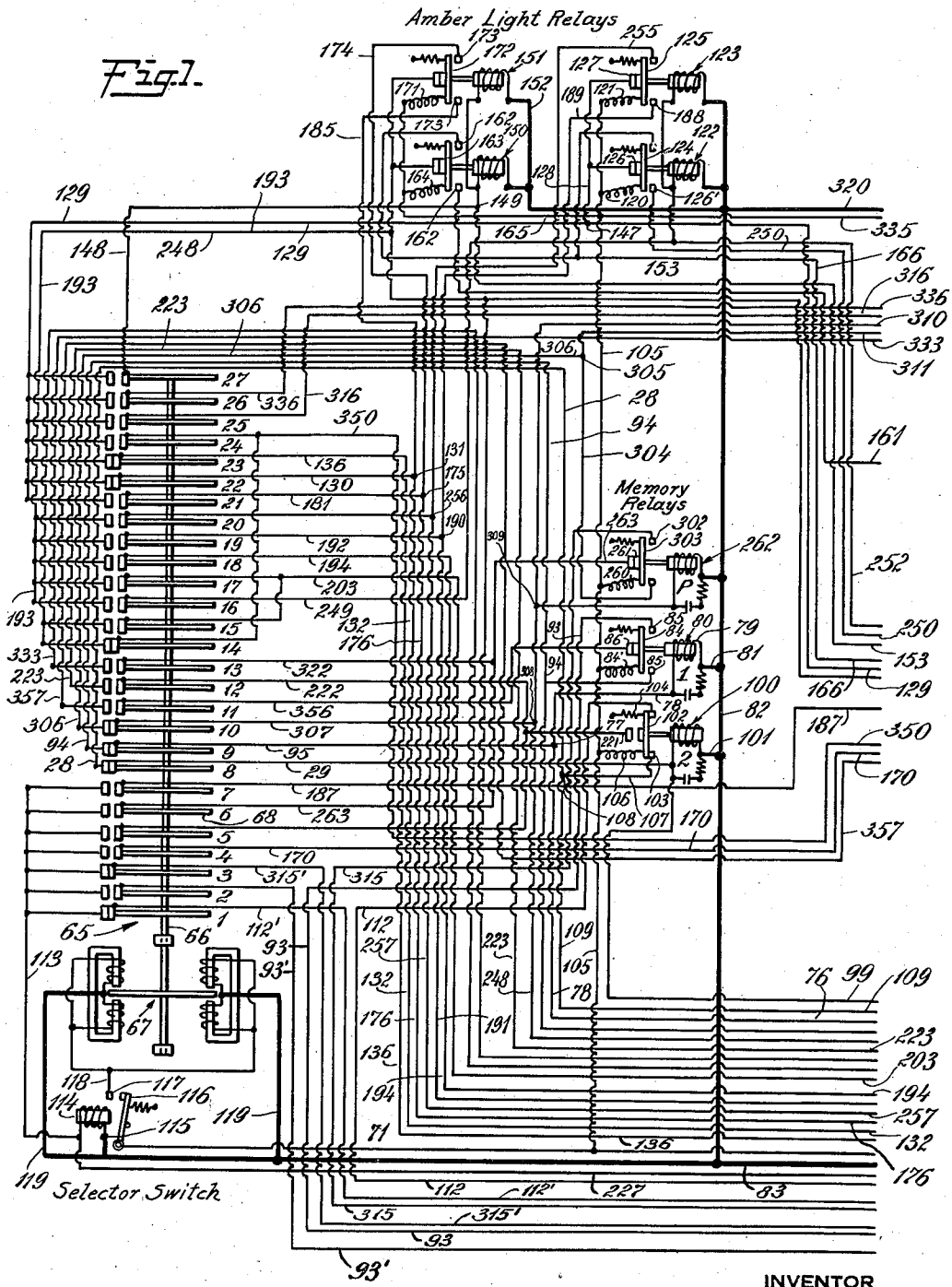
Jan. 17, 1939. P. P. HORNI 2,144,536

TRAFFIC SIGNAL

Filed July 8, 1936 5 Sheets-Sheet 1

Fig. 1.



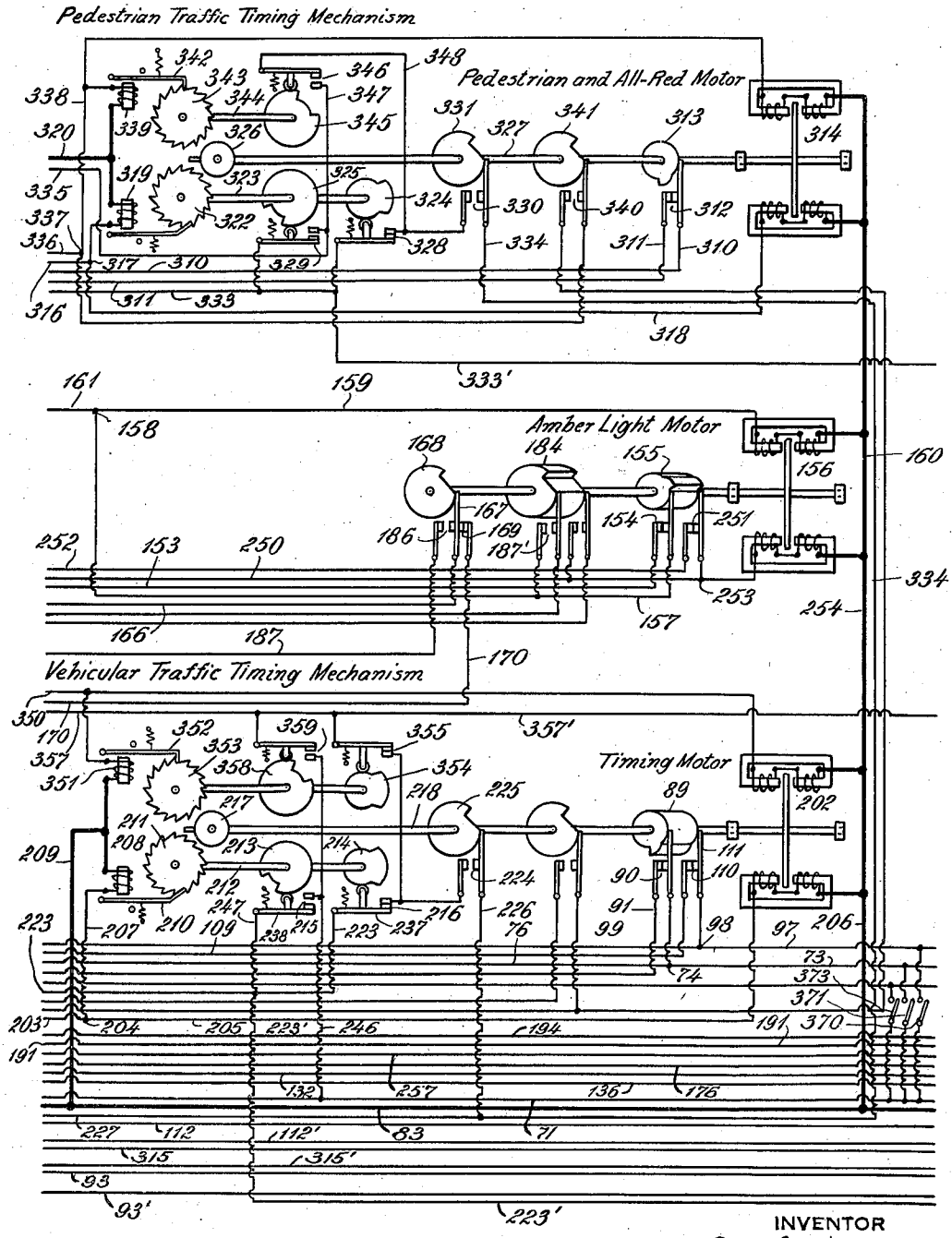
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Jan. 17, 1939. P. P. HORNI 2,144,536

TRAFFIC SIGNAL

Filed July 8, 1936 5 Sheets-Sheet 2

Fig. 2.



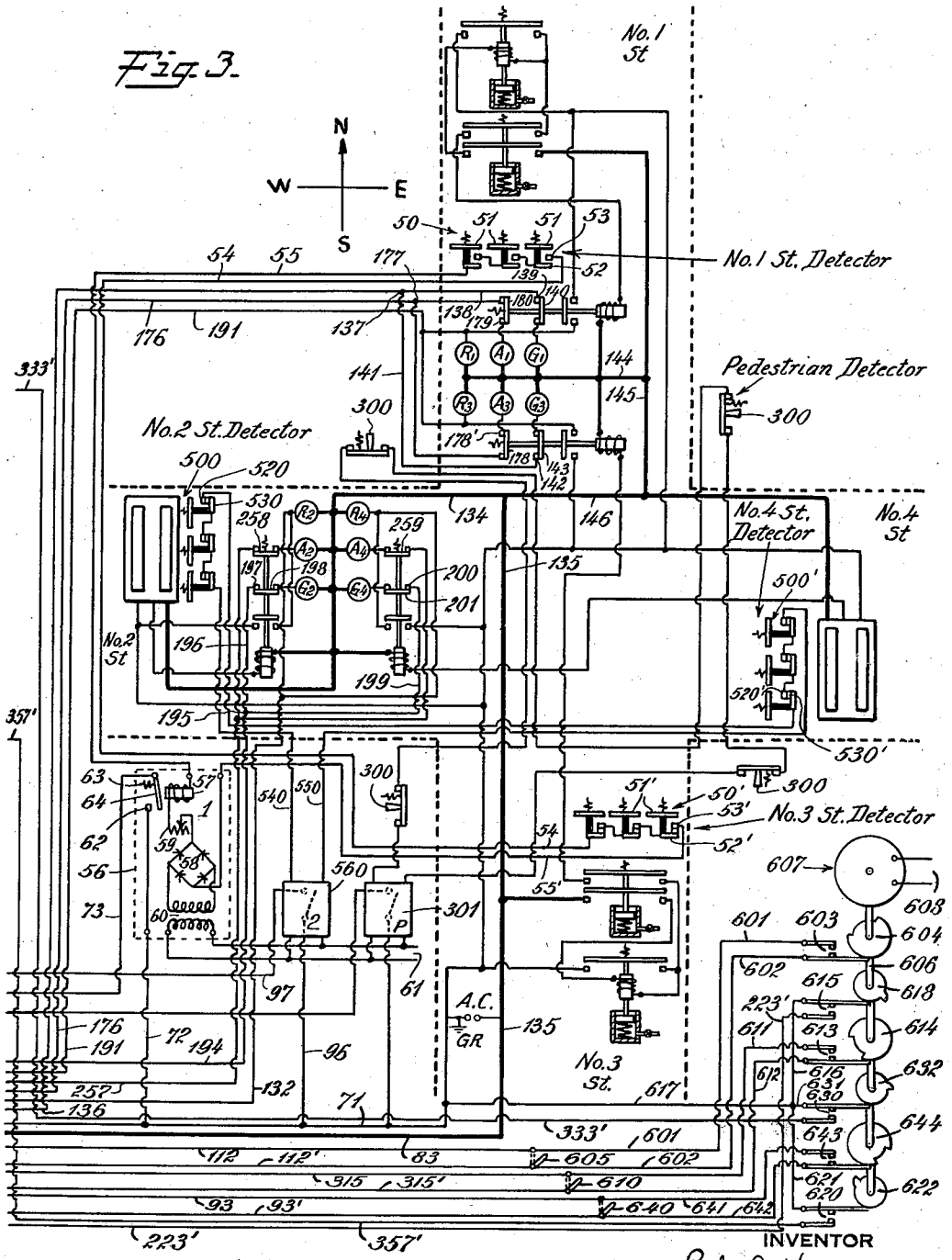
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TRAFFIC SIGNAL

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Fig. 3.



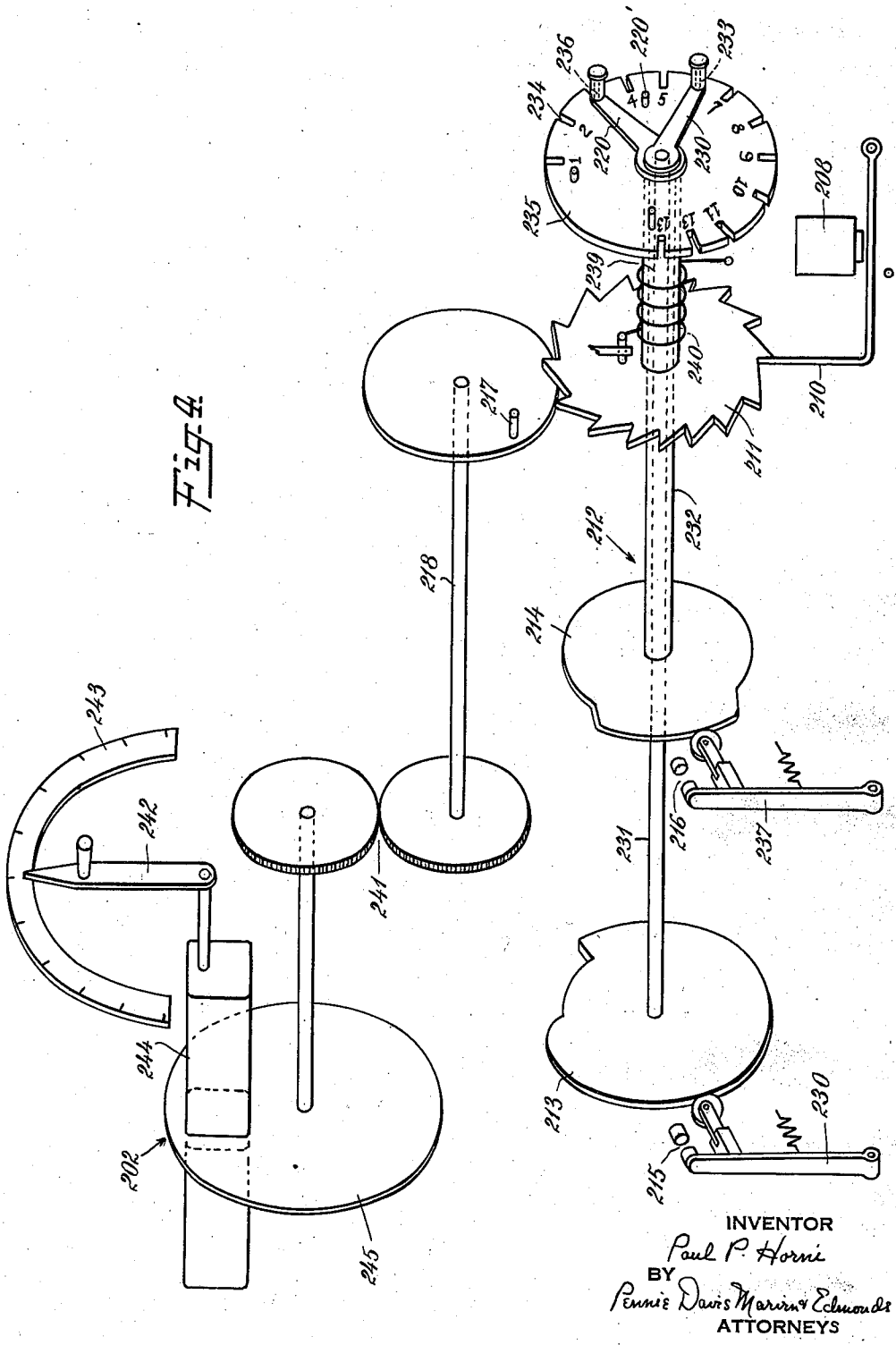
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Jan. 17, 1939. P. P. HORNI 2,144,536

TRAFFIC SIGNAL

Filed July 8, 1936 5 Sheets-Sheet 4

Fig. 4



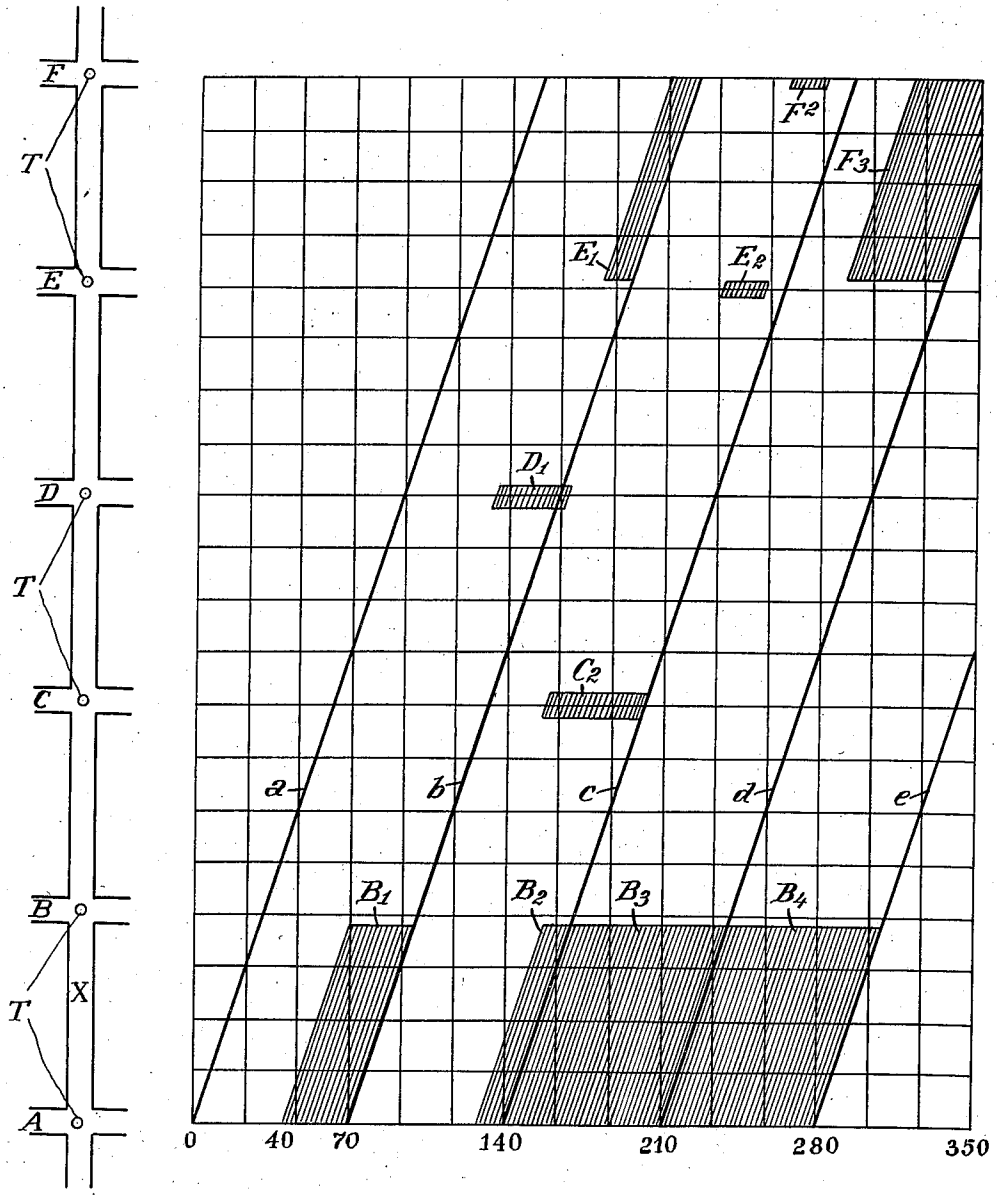
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TRAFFIC SIGNAL

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Fig. 5.



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UNITED STATES PATENT OFFICE

2,144,536

TRAFFIC SIGNAL

Paul P. Horni, Newark, N. J.

Application July 8, 1936, Serial No. 89,585

22 Claims. (Cl. 177—337)

This invention relates to automatic traffic regulating apparatus and is concerned more particularly with a novel apparatus of this type which is selectively operable within limits in accordance with and in response to the volume and nature of the traffic passing the street intersection where the apparatus is located, and which is subject in its operation to the influence of a time control. The new apparatus is especially adapted for use with one or more similar apparatus spaced along a through traffic lane at side street intersections thereof, to provide a traffic control system along the lane in which the individual control units for the intersections are operable in a predetermined time phase relation but are responsive within limits to the traffic conditions prevailing in the lane and the side streets thereof.

This application is a continuation-in-part of my copending application Serial No. 692,091, filed October 4, 1933.

For the purpose of simplicity in description, it will be understood that the term "unit" as used herein refers to a single traffic control apparatus for controlling flow of traffic at a single intersection of streets, while the term "system" as used herein refers to a plurality of traffic control units spaced along a through lane at street intersections thereof for controlling flow of traffic along the lane and its side streets.

Automatic traffic control systems of various forms have been devised heretofore for controlling the flow of traffic along a lane which is intersected at spaced intervals by cross streets. A common system for this purpose is one in which the individual traffic control units located at successive intersections are the familiar "prefixed timer" units which transfer the right of way from the lane to the cross streets and back to the lane in alternation at fixed time intervals, the individual units being adjusted to operate the traffic signals either simultaneously or progressively along the lane. Another form of system includes individual traffic control units of the so-called "fully actuated" type in which the streets forming the intersection at which each of the units is installed are provided with devices responsive to traffic approaching the intersection for appropriating control of the signals, the individual units being connected together electrically so that actuation of one of them results in corresponding actuation of the others. Still another form is one in which the individual traffic control units are of the "semi-actuated" or "normal go" type wherein traffic on the through lane retains the right of way until traffic on one or more of the cross streets initiates a signal circuit common to the units, whereby the right of way is temporarily transferred to the cross streets along the lane and is then restored to the lane after the expiration of a predetermined time interval.

Each of these systems has certain advantages and disadvantages depending on several factors, among which are the nature and volume of the traffic negotiating the lane and the streets which intersect it, variations in the volume and nature of traffic during different times of the day, or at different seasons of the year, and the like. For example, the traffic regulating system in which the individual control units are of the prefixed timer type is advantageous if the nature and volume of the traffic is substantially uniform along the through lane and the several cross streets, but if this is not the case the system periodically halts traffic along the through lane when there is no traffic on any of the cross streets to warrant the delay, or stops traffic on the cross streets when there is no traffic on the through lane, so that congestion instead of dispatch of the traffic results.

The system in which the individual control units are of the fully actuated type has distinct advantages for use along a traffic lane where the traffic is variable on the lane and the cross streets thereof, so that neither the lane nor any of the cross streets could properly be considered a main highway, and yet the though lane and cross streets pass such a considerable amount of traffic at certain times of the day or other periods that the individual control units are warranted in maintaining the right of way for as long a time as is necessary to dispatch the traffic negotiating the through lane or side streets. However, this system has the disadvantage that it is relatively expensive to install along traffic lanes where the traffic is substantially uniform on the through and side streets, because in that event the system is working most of the time, where the less expensive systems employing pre-fixed timer units would be of greater advantage. Also, where the through traffic lane passes more traffic than the cross streets, it is more appropriate to maintain the right of way on the through lane so as to dispatch the heavier traffic, rather than cause the through lane traffic to initiate a signal cycle each time after cross-traveling traffic has completed a signal cycle permitting it to negotiate the through lane. In addition, each of the control units along the through lane which make up the system is dependent in its operation on other units in the system to which it is electrically con-

nected, the interconnecting or synchronizing network between the units adding substantially to the cost and complexity of the system.

Systems of the type employing semi-actuated or normal go control units are of advantage where the traffic on the through lane along which the units are disposed is relatively heavy as compared to the traffic along the cross streets, since with systems of this type, heavier traffic on the through lane retains the right of way at all times, so that it is dispatched, unless and until traffic on one or more of the cross streets initiates the signal cycle by means responsive to its presence, to operate the "go" signals on all of the cross streets, the signal cycle upon completion restoring the right of way to the through lane. However, these systems are not satisfactory for use under conditions in which the traffic is variable along the through lane and side streets, nor where the traffic is substantially uniform or the through lane and side streets. Moreover, as in the fully actuated systems, each of the control units which make up the system is dependent in its operation on other units in the system, the separate units being interconnected by a special synchronizing network.

The present invention is directed to the provision of a novel automatic traffic control unit adapted for operation in time phase relation with other similar units along a traffic lane, whereby a complete traffic control system is established along the lane having all the advantages of the systems previously described, and in addition, being capable of automatically accommodating changing traffic conditions whether hourly, daily, or seasonally. The new traffic control unit may be operated either simultaneously or progressively with respect to the other units along the lane, and when operating in either manner it is automatically responsive within limits to the actual traffic conditions prevailing on the through lane and side street forming the intersection where the unit is located. The unit is complete and self-contained and when used in conjunction with other similar units, is independent of the other units in its operation. Accordingly, the time phase relation between the various units of a complete system may be established and maintained without the usual synchronizing network connected between the units.

The traffic control unit of this invention includes detector devices in or adjacent the through traffic lane and the cross street or streets constituting one of the intersections along the lane, the detector devices being responsive to the presence of traffic approaching the intersection in order to negotiate it. These detector devices, upon actuation by a unit of traffic, whether vehicular or pedestrian, operate corresponding memory devices which "remember" that a unit of traffic is seeking to negotiate the intersection, and accordingly appropriate control of the signal cycle to permit passage of the corresponding vehicle or pedestrian at the proper time, either upon completion of the signal cycle which was in progress at the time that the corresponding traffic unit actuated the detector device and operated the corresponding memory device, or at a time determined by a time-controlled mechanism to be described later. Vehicular detector devices are preferably located in the surface of the streets forming the intersection and the pedestrian detector devices are preferably located at or adjacent the corners of the intersection, both vehicular and pedestrian detectors having memory devices which have the same function, i. e., they prepare a circuit which is completed upon completion of the signal cycle then in progress or upon operation of the time-controlled mechanism to be described later, to permit negotiation of the intersection by the initiating unit of traffic at the proper time.

The memory devices, in response to actuation by the traffic detectors, energize mechanism including a selector switch which selects predetermined circuits or mechanisms for performing various functions, depending upon prearrangement of the traffic control unit and upon the nature and volume of the traffic seeking to negotiate the intersection, within limits determined by the time-controlled mechanism. For example, the selector switch prepares circuits to timing devices which determine the duration of the right of way periods for the various streets in accordance with certain predetermined factors, among which are the duration of the initial period of time during which right of way is to be maintained for pedestrian, through lane or cross street traffic, the duration of the extended period of time during which right of way is to be maintained to such traffic, the quantity of traffic on the respective streets, and the operation of an independent time-controlled mechanism to be described.

The initial period is adjustable in accordance with observed traffic conditions, i. e., the initial period may be shortened or lengthened in accordance with the volume of traffic which desires to negotiate an intersection during any one signal cycle. During this initial period, the traffic units crossing detector devices are rendered ineffective or prevented from interfering with the signal mechanism to appropriate control thereof, but after termination of the initial period, the actuation by other units of traffic become effective.

The extension period is determined by traffic seeking to cross the intersection on the street having the right of way upon termination of the initial period, and the number of units of time comprising the extension period is determined by traffic units following the traffic unit which originally initiated the extension period on the street which had the right of way during the previous initial period, but the maximum number of units of time by which the extension period may be lengthened is predetermined. In other words, within certain limits including that which may be imposed by the time-controlled mechanism to be described, the duration of the right of way on any street may be extended as many units of time after the termination of the initial period as there are units of traffic following the traffic which negotiated the intersection during the initial period.

During the additional units of time forming the extension period, massed traffic, single units of traffic, or any intermediate number of units of traffic, may negotiate the intersection without affecting the time extension mechanism, and it is only during each extended period of time that a following unit of traffic may set up an additional unit of time to further extend the extension period. That is to say, during the extension period, except at predetermined moments, the devices responsive to traffic are locked against actuation by the traffic or are rendered ineffective to interfere with or otherwise affect the signal mechanism.

If there has been no actuation of detector devices by pedestrian or by vehicular traffic approaching on a street other than that having the right of way, prior to termination of the initial and extension periods, as remembered by the corresponding memory devices, the street previously having the right of way maintains the right of way. If one of the memory devices has been actuated at or previous to the time when the initial period expires, or when the extension period expires if set up, the right of way is eventually transferred to a pedestrian or to the street on which the initiating traffic is waiting to cross the intersection.

The time-controlled mechanism referred to influences the duration of the right of way periods for cross street traffic and pedestrians, and also affects the duration of the right of way periods for the through lane traffic. The mechanism includes a device operated by timing means, such as a constant speed motor, for rendering the memory devices for cross street and pedestrian traffic incapable of appropriating the right of way from the through lane to accord it to such traffic, except at predetermined time intervals. Accordingly, after completion of the signal cycle for the through lane, the memory devices for pedestrian and cross street traffic, even though they have been actuated by the corresponding detector devices to "remember" that a corresponding traffic unit is seeking to negotiate the intersection, must wait for the time-controlled device to operate before they can energize the mechanism for changing the traffic right of way. The time-controlled mechanism also includes a device which operates at predetermined time intervals to terminate the right of way on the through lane and accord right of way to cross street or pedestrian traffic, in the event that such traffic has actuated a corresponding memory relay before the device operates, and under these conditions right of way will be accorded to cross street or pedestrian traffic even though extension periods are in progress on the through lane at the particular time in which the device operates. In addition, the mechanism effects the cross street and pedestrian signal operating mechanisms and includes a device which prevents appropriation of the right of way from the cross street until predetermined time intervals which are fixed by timing means, and also devices which operate at predetermined time intervals to terminate the right of way for cross street and pedestrian traffic and return it to waiting traffic on the through lane, regardless of whether extension periods are being set up by cross street or pedestrian traffic. Consequently, the traffic regulating unit must necessarily operate at predetermined time intervals to accord the right of way to waiting traffic on the through lane, cross street, and pedestrian lane, respectively, regardless of other conditions, but is free to operate in accordance with prevailing traffic conditions at the intersection within the limits provided by the timing mechanism.

In order to convert the fully actuated time-controlled traffic regulating unit just described into a semi-actuated time-controlled unit, switching devices are provided whereby detector devices of the through traffic lane are disabled, and means are provided whereby the right of way is restored to the through lane either by the time-controlled mechanism or at the end of a signal cycle, the detector devices in the other streets remaining responsive to traffic approaching the through lane in order that the right of way may be transferred to this traffic at the proper time as determined by the time-controlled mechanism. In this way, the traffic control unit of this invention may be readily converted from a fully actuated unit to a semi-actuated or normal go unit, and vice versa. Also, by means of the switching devices all of the detector devices may be disabled to convert the system into a prefixed timer system wherein right of way is alternately transferred from one street to another and back again, in which case the time-controlled mechanism may be disabled by other switching devices.

It will be seen that by employing a plurality of the traffic control units of this invention along a through traffic lane at the cross street intersections thereof, the several units may be made to operate in a predetermined time phase relation by proper adjustment of their respective time-controlled mechanisms. That is, by adjusting the timing devices which permit the cross street and pedestrian traffic memory devices to become effective, the various control units may be prevented from appropriating the right of way from the through lane following completion of their signal cycles until their time-controlled mechanism permit such appropriation, whereupon the right of way will be accorded to waiting traffic on the cross streets either simultaneously or progressively, depending on the relative adjustment of the time-controlled mechanisms of the respective units. By adjusting the timing devices which influence the cross street and pedestrian right of way periods, the various control units may be made to return the right of way to waiting traffic on the through lane either simultaneously or progressively, if the signal cycles for pedestrian or cross street traffic on the several cross streets have not already been completed.

It will be apparent from the foregoing that with the new traffic control unit any traffic conditions may be handled expeditiously and with precise consideration of the volume and nature of the traffic and the changes in the volume and nature of the traffic at any time. A number of the units can be mounted on any through lane at the cross street intersections thereof and readily adjusted at any time to conform to the traffic requirements of the through lane and cross streets, the traffic on the through lane being assured of a continuous right of way across the successive intersections at the proper time intervals.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which

Figs. 1, 2 and 3 jointly illustrate the complete schematic circuit diagram of the selective and automatic traffic regulating unit of this invention, the three sheets of drawings on which these figures appear being arranged to be laid side by side to form the complete diagram;

Fig. 4 illustrates the arrangement of the initial and extension period counting mechanism; and

Fig. 5 is a typical traffic flow diagram showing the flow of traffic along a through lane provided with the new control units at cross street intersections thereof.

Referring to these drawings, Figure 3 indicates a cross or X intersection of two through streets, boulevards or highways, and this form of inter-

section is employed merely for purposes of illustration of the invention, it being understood that the invention is applicable with equal facility to Y, T or other forms of intersections. For convenience, the traffic lanes which pass entirely through an intersection whether on the straight-away, curve or angle are called main highways, through streets, or boulevards, while the traffic lanes which approach the intersection, whether parts of the through streets, main highways or boulevards, or single streets which terminate in the intersection, are called streets. Thus, in Figure 3, the through street, boulevard or highway which runs north and south is indicated as comprising two streets terminating in the intersection, and these streets are designated No. 1 street and No. 3 street, while the two east and west streets are designated No. 2 street and No. 4 street. Also, for convenience, the highway which runs north and south and comprises the No. 1 and No. 3 streets will be referred to as a through traffic lane, and by this is meant a traffic lane which is intersected at intervals along its course by streets similar to the No. 2 and No. 4 streets, which will be referred to for convenience as cross streets.

Suitably located at the intersection and visible from all approaching streets is at least one visual signal device of conventional design. Preferably, a signal device is provided for each street of the intersection in the form of electric lights, including green, amber and red lights, although other forms and arrangements of signal means may be employed. The lights which face No. 1 street are designated G—1, A—1 and R—1; the lights which face No. 3 street are designated G—3, A—3 and R—3. Similarly, the lights which face No. 2 street are designated G—2, A—2 and R—2, and the lights which face No. 4 street are designated G—4, A—4 and R—4.

The Traffic Detecting Devices

Located on the right-hand side of No. 1 street, and preferably in the surface of the roadway so as to be responsive to vehicles passing thereover, is a detector 50 comprising a plurality of aligned segments 51 each carrying a contact 52 normally engaging a corresponding contact 53, these contacts being connected in series with wires 54 and 55. A similar vehicle detector 50′ comprising aligned segments 51′ is located in the surface of the right-hand side of No. 3 street. These segments 51′ each control a set of closed contacts 52′—53′, which are connected in series with the contacts of detector 50 and with detector relay 56 through wires 54, 55 and 55′. These vehicle detectors are formed in segments 51 and 51′ so that more rapid, effective and simpler response by a vehicle passing over one of them is obtained than if the street detector were a long strip which is necessarily bodily movable in its entirety to close the contact in response to actuation by a vehicle. As indicated and as will more fully appear, the circuits of all detectors are closed so that they cannot be short-circuited by dirt, ice, or snow or the like accumulating between contacts as is the case with open circuit detectors, and a surer, more positive response results since it is ordinarily easier to break a circuit than to make one. Furthermore, as will be explained later, even if the detector circuits of this system are broken or the detector contacts stick open for any reason, the traffic system is not disabled but automatically becomes a "pre-fixed timer" system as to the street having the disabled detector circuit.

Wire 55 leading to No. 1 detector relay 56 is connected through coil 57 to one side of a rectifier 58 and wire 55′ is connected to the opposite side of rectifier 58. A variable resistance 59 between coil 57 and rectifier 58 varies the degree of electromotive force developed in coil 57. The input of rectifier 58 is connected to the secondary of a transformer 60, the primary of which is connected to a suitable source of alternating current, such as 110-volt lighting current conveniently obtained from supply line 61. In actual practice the transformer 60 delivers approximately one and one-half volt alternating current to the rectifier which converts it into approximately one volt twenty milliampere direct current, which is impressed upon the detector circuit including coil 57. Normally held disengaged from stationary contact 62 by energized coil 57 is a needle armature 64 which is urged into engagement with contact 62 by light spring 63 when coil 57 is de-energized by the opening of its circuit, i. e., when one of the detectors 50 or 50′ is actuated.

The surface of the roadway of No. 2 street and No. 4 street, are provided with similar vehicle detectors 500 and 500′ which, when actuated, break respective closed contacts 520 and 530 or 520′ and 530′ connected in series to wires 540 and 550 leading to No. 2 detector relay 560, which is like No. 1 detector relay 56 in every respect and is therefore not illustrated in detail.

The Selector Switch

Included in the traffic regulating system of this invention is a circuit selector switch 65, which is illustrated diagrammatically in Figure 1, and which comprises a shaft 66 rotatable by an eddy current motor 67, or the like, and carrying a plurality of spaced cam discs 68 each effecting the engagement and disengagement of a pair of contacts which are numbered serially from 1 to 27 on Figure 1 of the drawings for convenience. As the selector switch 65 is rotated periodically by the motor its cams 68 close certain of the sets of contacts and open others to select certain corresponding circuits for operation and open other corresponding circuits. Various combinations of circuits may be selected simply by adjusting the cams 68 angularly on shaft 66 in a manner readily understood, means, not shown, being provided for that purpose. In the preferred arrangement, the selector switch has eight positions, in each of which certain contacts are closed and the signal lights are energized in accordance with the following table:

First position

Stop No. 1 street and No. 3 street green (G—1 G—3)
No. 2 street and No. 4 street red (R—2 R—4)
Contacts 1—3—8—9—10—14—22—23 closed.

Second position

No. 1 street and No. 3 street amber (A—1 A—3)
No. 2 street and No. 4 street red (R—2 R—4)
Contacts 5—7—8—9—10—21—22—27 closed.

Third position

No. 1 street and No. 3 street red (R—1 R—3)
No. 2 street and No. 4 street green (G—2 G—4)
Contacts 4—9—10—12—17—18—19 closed.

Fourth position

Stop No. 1 street and No. 3 street red (R—1 R—3)
No. 2 street and No. 4 street green (G—2 G—4)
Contacts 2—3—8—9—10—15—18—19 closed.

Fifth position

No. 1 street and No. 3 street red (R—1 R—3)
No. 2 street and No. 4 street amber (A—2 A—4)
Contacts 6—7—8—9—10—16—19—20 closed.

Sixth position

No. 1 street and No. 3 street red (R—1 R—3)
No. 2 street and No. 4 street amber (A—2 A—4)
Contacts 4—8—9—13—19—20—21—22—25 closed.

Seventh position

No. 1 street and No. 3 street red (R—1 R—3)
No. 2 street and No. 4 street amber (A—2 A—4)
Contacts 7—8—9—10—19—22—26 closed.

Eighth position

No. 1 street and No. 3 street green (G—1 G—3)
No. 2 street and No. 4 street red (R—2 R—4)
Contacts 8—10—11—22—23—24 closed.

In the interests of simplicity and convenience, those circuits which are completed by the selector switch or complete circuits not including selector switch contacts will first be described with the traffic control unit or system operating as a fully actuated controller independently of the influence of the time-controlled mechanism which is adapted to synchronize its operation with that of other units.

Assume that No. 1 and No. 3 streets have the right of way, i. e., that the selector switch **65** is in the first position indicated in the foregoing table, and that a vehicle approaching the intersection on No. 1 or No. 3 streets actuates the vehicle detector **50** or **50'** to operate No. 1 detector relay **56** so that needle armature **63** engages contact **62** in the manner described. Since the No. 1 and No. 3 streets have the right of way, nothing happens except that No. 1 memory relay **80** is energized by a circuit traceable from an alternating current source AC, one terminal of which is grounded as shown at GR, wires **71** and **72**, contact **62** of detector relay **56**, needle armature **63**, wire **73** or terminal **74** where the circuit divides, one branch following wire **76** to terminal **77** where the circuit again divides, one branch leading by wire **78** to the coil **79** of No. 1 memory relay **80**, the circuit of which is completed by wires **81**, **82** and **83** to the other side of the alternating current source AC. Armature **84** of memory relay **80** is accordingly drawn into engagement with front contacts **85** and breaks back contact **86**. The other branch circuits will be described later.

The bridging of contacts **85** by armature **84** of memory relay **80** establishes a holding circuit therefor, which is traceable from the alternating current source AC, by wires **71** and **105**, pigtail **84'**, armature **84**, contact **85**, wire **94**, closed contact **9** of selector switch **65**, wire **95**, terminal **77**, relay **80** and back to the alternating current source AC by wires **82** and **83**. Thus, memory relay **80** remains energized for a period of time determined by selector contacts **9**. The circuits of the coils of all memory relays include a condenser and a resistance to suppress arcing between the delicate needle armatures and the contacts of the corresponding detector relays. The latter are accordingly supersensitive and very accurate.

SELECTOR SWITCH FIRST POSITION

Assuming that, with the selector switch in the first position, No. 1 and No. 3 streets having the right of way, as indicated in the foregoing table, a vehicle approaching on either No. 2 or No. 4 street actuates respective vehicle detector **500** or **500'**, No. 2 detector relay **560** releases its needle armature to connect wires **96** and **97** and initiate a circuit traceable from the alternating current source AC through wires **71** and **96**, detector relay **560**, wire **97** to terminal **98** where the circuit divides, one branch leading by wire **99** to the coil of No. 2 memory relay **100**, the circuit of which is completed to the other side of the alternating current source AC by wires **101**, **82** and **83**. The armature **102** of memory relay **100** accordingly bridges front contacts **103** and breaks back contacts **104**. Energization of memory relay **100** completes a holding circuit for the relay and a circuit to selector switch motor **67**. The holding circuit has two shunts, one traceable from the alternating current source AC, wires **71** and **105**, pigtail **106**, armature **102**, front contact **103**, wire **107** to terminal **108**, branch wire **109**, closed contacts **110** controlled by the follower **111** of cam **89**, terminal **98**, wire **99**, relay **100**, wires **82** and **83** to the alternating current source AC; and the other shunt is traceable from terminal **108** by wire **28** to closed contacts **8** of selector switch **65**, wire **29**, memory relay **100** and wires **101**, **82** and **83** back to the alternating current source AC.

The selector switch motor circuit is traceable from the alternating current source AC through wires **71** and **105**, pigtail **106**, memory relay armature **102**, relay contact **103**, wire **112**, through closed switch **605** to wire **112'**, closed contact **1** of selector switch **65**, wire **113**, relay **114**, and wires **115** and **83** back to the alternating current source AC. Energized relay **114** pulls its armature **116** into engagement with contact **117** to complete a circuit from the alternating current source AC by wire **71**, armature **116**, contact **117**, wire **118**, the poles of selector of motor **67**, and wires **119** and **83** back to the alternating current source AC.

SELECTOR SWITCH SECOND POSITION

Selector motor **67** rotates to the second position to open **1—3—14—23** contacts, close contacts **5—7—21—27**, and maintain contacts **8—9—10—22** closed, as indicated in the foregoing table. In this movement it opens the circuit of the No. 1 and No. 3 street green lights G—1 and G—3, but maintains the circuit of the No. 2 and No. 4 street red lights R—2 and R—4. The circuits of these lights are controllable by respective selector contacts **23** and **22** and are traceable from the alternating current source AC by wires **71** and **105**, pigtails **120** and **121** of respective parallel relays **122** and **123**, their armatures **124** and **125**, their closed back contacts **126** and **127**, wires **128** and **129**, selector contacts **22** and **23**, wire **130** leading from the former to terminal **131**, a branch wire **132**, red lights R—2 and R—4, and wires **134** and **135** back to the alternating current source AC, and wire **136** leading from selector contacts **23** by wire **136** to terminal **137** where the circuit divides, one traversing wire **138**, relay contacts **139**, and armature **140** to green light G—1 and the other branch traversing wire **141**, relay con-

tact 142, and armature 143 to green light G—3, both of these green lights being connected by wires 144, 145, 146 and 135 to the alternating current source AC. Thus, when contact 23 of selector switch 67 is broken as the switch moves to second position in the manner described, the green lights G—1 and G—3 signaling the right of way to traffic on No. 1 and No. 3 streets are extinguished, but red lights R—2 and R—4 remain energized because selector contacts 22 remain closed.

The selector switch 65, in moving from first to second position, also breaks its energizing circuit by breaking contact 1, so that the selector switch 65 stops in the second position. The selector switch 65 also maintains shunt holding circuit of memory relay 100 closed by maintaining its contact 8 closed in moving from first to second position.

The closing of selector contacts 27 initiates a circuit traceable from the alternating current source AC, by wires 71 and 105, pigtail 120, the contacts 126 of relay 122, wire 128, terminal 147, wire 129, selector contacts 27, wire 148, terminal 149 where the circuit divides, one branch leading to parallel relays 150 and 151, and wires 152, 82 and 83 back to the alternating current source AC, and the other branch from terminal 149 following wire 153 to normally closed contacts 154 controlled by cam 155 of amber light motor 156, wire 157 to terminal 158 where the circuit divides one branch following wire 159 to amber motor 156 and back to the alternating current source AC by way of wires 160 and 83. Amber motor 156 accordingly begins to make one complete revolution when it breaks its own circuit by opening contacts 154.

The other branch from terminal 158 follows wire 161 to front contacts 162 of relay 150, which were bridged by armature 163 when the relay was energized by closure of selector contacts 27 in the manner described.

The armature 163 of relay 150 is connected to one side of the alternating current source AC by pigtail 164 and wires 165, 105 and 71 so that the circuit just traced constitutes a holding circuit from relay 150, which will be broken when cam 155 of amber motor 156 opens contacts 154.

The closure of relay 151 establishes a circuit traceable from the alternating current source AC through wires 71, 105 and 165, pigtail 171, armature 172 of relay 151, contact 173 of relay 151, wire 174, terminal 175 where the circuit divides, one branch traversing wire 176 to terminal 177 where the circuit divides, one branch leading to contacts 178' bridged by armature 178 to amber light A—3, and the other branch leading to contacts 179, bridged by armature 180 to amber light A—1, both light A—1 and A—3 being connected to the other side of the alternating current source AC by wires 144, 145, 146 and 135. Thus, the amber lights flash a warning to traffic approaching the intersection on No. 1 and No. 3 streets.

The other branch of the circuit is a shunt circuit including the amber A—1 and A—3 lights, wire 176, terminal 175, wire 181, closed contacts 21 of selector switch 67, wire 129, terminal 147, closed back contacts 126 of relay 122, pigtail 120, and wires 105 and 71 back to the alternating current source AC. The other branch circuit from relay 151 may be traced from the alternating current source AC through wires 71, 105 and 165, pigtail 171, armature 172, contact 173, wire 185, terminal 131 where the circuit divides, one branch following wires 132 to red lights R—2 and R—4 back to the alternating current source AC by way of wires 134 and 135, so that relay 151 assumes control of the red lights still showing to traffic on No. 2 and No. 4 streets which initiated the signal cycle being described as well as of the amber lights A—1 and A—3.

Energized amber motor 156 makes one complete revolution. As it does so it opens contact 154 to open the holding circuit for relays 150 and 151, but these relays remain energized because selector contact 27 remains closed. Rotation of amber motor 156 also momentarily closes contacts 186, which complete a circuit from the alternating current source AC by wires 71, 105 and 165, pigtail 164, armature 163, contacts 162, wire 166, contacts 186, wire 187, closed contacts 7 of selector switch 65, wire 113, selector motor 67, and wires 119 and 83 back to the alternating current source AC. Selector motor 65 accordingly advances one step to the third position designated on the foregoing table, the selector contacts 4—12—17—18—19 being closed, and contacts 5—7—8—21—22—27 being opened while contacts 9 and 10 remain closed.

Selector Switch Third Position

Opening of selector contacts 21, 22 and 27 extinguishes the No. 1 and No. 3 street amber lights A—1 and A—3 and the No. 2 and No. 4 red lights R—2 and R—4, and since amber motor 156 breaks its own circuit the contacts controlled by its cams 155, 168 and 184 are restored to their initial position which is illustrated in the drawings. Although one shunt holding circuit of memory relay 100 is opened by opening of selector contacts 8, the other shunt remains energized through closed contacts 110 of timing motor cam 89, and the memory relay remains closed.

The circuits selected by the selector motor in its third position include two circuits, one energizing No. 1 and No. 3 street red lights R—1 and R—3 and the other energizing No. 2 and No. 4 street green lights G—2 and G—4. Selector contacts 18 and 19 control these light circuits and these circuits may be traced from the alternating current source AC by way of wires 71 and 105, wire 165, pigtail 164 of relay 150, armature 163, back contact of relay 150, wire 193 to selector contacts 19, terminal 190 where the circuit divides, one branch following wire 191 to R—1 and R—3 lights and by wires 144, 145, 146 and 135 back to the alternating current source AC, so that the red lights facing No. 1 and No. 3 streets are energized to stop the traffic approaching the intersection on these streets which originally had the right of way. The circuit from wire 193 also includes closed selector contacts 18, wire 194 to terminal 195 where the circuit divides, one branch traversing wire 196, relay contacts 197, relay armature 198, No. 2 street green light G—2, and wires 134 and 135 to the alternating current source AC while the other branch from terminal 195 follows wire 199 to relay contacts 200, relay armature 201, No. 4 street green light G—4 and back to the alternating current source AC by way of wires 134 and 135. Thus, traffic approaching the intersection of No. 1 and No. 3 streets is stopped by red lights R—1 and R—3 and the right of way is signaled by green lights G—2 and G—4 to traffic waiting on No. 2 and No. 4 streets, which had energized vehicle detectors 500 or 500' to initiate the signal cycle being described.

The Timing Mechanism

The duration of the signal cycle is timed from

now on by timing motor 202, the circuit of which is controlled by closed contacts 17 of selector switch 65. The circuit of the timing motor is traceable from the alternating current source AC, wires 71, 105 and 165, pigtail 164 of relay 150, its armature 163, its closed back contacts, wire 193, closed contacts 17 of selector switch 65, wire 203, terminal 204 where the circuit divides, one branch following wire 205 to windings of timing motor 202 and back to the alternating current source AC by way of wires 206 and 83, so that timing motor 202 accordingly begins to revolve. The other branch of the circuit from terminal 204 follows wire 207 to magnet 208 of limit timing mechanism and wires 209 and 83 back to the alternating current source AC. Energization of magnet 208 causes it to draw its armature pawl 210 into engagement with ratchet wheel 211, which is secured on a shaft 212 carrying cams 213 and 214. The cams 213 and 214 may be independently preset manually by handles 220 and 230 into any angular position relatively to each other and relatively to the ratchet wheel 211, such as by clutching devices between the cams and the shaft 212, so that a greater or less time is required for the timing motor 202 to rotate the cams 213 and 214 to a point where they will close respective contacts 215 and 216. The means for rotating shaft 212 comprises a star wheel or equivalent device 217 mounted on shaft 218 of timing motor 202 and arranged to engage ratchet wheel 211 so as to step it through a small angle for each revolution of timing motor 202 in a manner readily understood. Armature pawl 210 merely serves to hold ratchet wheel 211 in adjusted position.

The foregoing describes the general arrangement of the initial and extension period cam mechanism in connection with the diagrammatic representation thereof shown in Figure 2, but a more complete representation of the preferred construction of this mechanism is illustrated in Figure 4. In this arrangement the shaft 212 comprises three telescoped shafts, the inner one 231, carrying extension period cam 213 at one end and the crank handle 230 at its other end. This crank handle carries a movable locking pin 233 at its free end adapted to be inserted in any one of a series of notches 234 formed in disc 235, except the notch occupied by the locking pin 236 of initial period crank handle 220 and those notches between initial period locking pin 236 and the zero index of disc 235. By stop means, 220' the movement of initial period crank handle 220 is limited to four positions, although it may have a greater or less number of positions, depending upon requirements. The extension period crank handle 230 may have any one of a number of positions, beginning with the notch 234 next to the stop 220' for the initial period crank handle pin 236 and ending with the notch marked "13", for example, although the handle may be movable to any other number of positions. In the particular arrangement illustrated, all notches 234 represent uniform periods of time, the initial period being one, two, three or four time periods in duration, and the extension period any number of additional periods in duration.

Initial period crank handle 220 is secured on one end of center telescoping shaft 232 having at its other end the initial period cam 214. This cam has a cam follower 237 controlling contacts 216 while extension period cam 213 has a cam follower 238 controlling contacts 215. The disc 235 is secured on one end of outer telescoping shaft 239 having at its inner end the ratchet wheel 211, engageable by pawl 210 when the magnet 208 is energized to hold the wheel 211 in any adjusted position against the restoring action of spring 240, which returns the cams 213 and 214, disc 235, and ratchet wheel 211 to initial position when pawl 210 is released upon deenergization of magnet 208.

The ratchet wheel 211 and the cams 213 and 214 are stepped or indexed angularly by pawl 217 on the shaft 218 driven through gears 241 by timing motor 202 as the latter rotates in the manner described. The speed of timing motor 202 is regulated manually by means of crank handle 242 which, when moved angularly across scale 243 shifts eccentric pole pieces 244 relatively to disc armature 245. These pole pieces 244 are of the shaded laminated type, and, when shifted, their resultant torque on disc armature 245 of timing motor 202 is increased or decreased, the speed of the latter increasing or decreasing in proportion to this torque. In this way the intervals for vehicle movements on the streets are adjustable. The speed of the other motors may be adjusted in the same way.

The arrangement of the initial period and extension period timing mechanism for No. 1 and No. 3 street traffic is precisely the same as that of the No. 2 and No. 4 street traffic, which has just been described. This mechanism appears directly above the timing mechanism just described, being also controlled by timing motor star wheel or pawl 217 in accordance with the operations of No. 1 memory relay 80, the selector switch 65 and other appurtenant parts of the No. 1 and No. 3 street traffic controlling mechanism.

The Initial Period

The timing motor 202 controls the green and red lights for all streets and when it is energized it rotates cam 214, which, in accordance with its angle "pre-set" by handle 220, determines the duration of the "initial period" of operation of the signal cycle to provide the right of way to traffic which initiated the signal cycle, in this case the traffic on No. 2 or No. 4 streets. The term "initial period" means that period of time during which all vehicles which follow the cycle-initiating vehicle and which pass the vehicle detectors 500 and 500', will have time to clear the intersection before the signal changes and will have no influence on the mechanism even though they actuate the vehicle detector. That is, the "initial period" means that period of time during which initial period cam 214 maintains its contacts 216 open. Until and unless contacts 216 are closed by initial period cam 214, timing motor 202 will continue to rotate, because contacts 216 controlled by cam 214 are in the circuit of motor 67 of selector switch 65, which controls timing motor 202. The circuit is traceable from the alternating current source AC, wires 71 and 105, pigtail 106, armature 102 of relay 100, closed back contacts 104, wires 221 and 222, closed contacts 12 of selector switch 65, wire 223, contacts 216, contacts 224 controlled by cam 225 of timing motor 202, wires 26 and 27, relay 114, and back to the alternating current source AC by wire 83. Relay 114 closes the selector motor 67 circuit and starts the latter, which then moves selector switch 65 to fourth position. It should be noted that timing motor contacts 224 will not complete the selector motor circuit unless initial period contacts 216

are closed, so that timing motor 202 must continue to rotate until such time that the feeling action of its cam 225 finds contacts 216 closed and this time is predetermined by the manual setting of cam 214 by handle 220.

THE EXTENSION PERIOD

After the sequence of operations heretofore described, and with the selector switch still in its third position, traffic on No. 1 and No. 3 streets, or a pedestrian, cannot appropriate control of the system. However, following traffic on No. 2 or No. 4 streets may, near the end of the initial period, retain control of the signal mechanism for an additional time by setting up one or more units of an extension period. Consider the extension period. During the major initial portion of the initial period, any energization of the memory relay 100 by reason of following traffic in No. 2 and No. 4 streets is ineffective because of the periodic opening of the holding circuit for this relay by the opening of contacts 110 of cam 89. However, in the final revolution of the timing shaft 218 during which the initial period cam 214 contacts 216 close, actuation of detectors in No. 2 and No. 4 streets result in setting up an extension period. Considering this final revolution of shaft 218, after the contacts 110 have been opened and reclosed, thereby deenergizing memory relay 100 if energized, the reenergization of memory 100 by following traffic on No. 2 and No. 4 streets results in preventing the energization of the selector switch motor 67 by the closing of contacts 224 at the end of the final revolution of shaft 218. It should be noted that initial period cam 214 completes its timed revolution and closes its contacts 216 to prepare the circuit of selector switch motor 67 for closure by cam 225 of timing motor 202 in the manner described. However, if memory relay 100 is energized at the time that contacts 216 and contacts 224 are closed, the circuit to the selector switch motor 67 is not completed in the manner described and the selector switch does not move to fourth position, but remains in third position.

During that part of the first extension period prior to the momentary opening of contacts 110, vehicles may cross No. 2 and No. 4 street vehicle detectors 500 and 500' without affecting the signal circuit. It is only after contacts 110 have opened and reclosed, thus deenergizing memory relay 100, that a second additional extension period may be set up by a No. 2 or No. 4 street vehicle and this must take place before timing motor cam 225 closes the selector switch motor 67 circuit prepared by initial period cam contacts 216. Otherwise, selector switch 65 will be advanced to fourth position and it will be too late for a second increase of the extension period.

Assuming that a second impulse by a vehicle on No. 2 or No. 4 streets is imparted to vehicle detectors 500 or 500' between the time that memory relay 100 has been reset by timing motor cam 89 and the time that timing motor cam 225 closes the selector switch motor 67 circuit, memory relay 100 and its holding circuit will be reenergized and the second time unit of the extension period set up and guarded against interference from other impulses in the manner described. These units of time are added to increase the extension period as often as there are actuations of detectors 500 or 500' in the No. 2 and No. 4 streets during the safety period, (that is, the period from the time that contacts 110 have opened and reclosed to the time that contacts 224 close) until the total number of possible added units are used up as predetermined by the setting of extension period crank handle 230, the extension period cam 213 being indexed one notch during each extension unit of time until it finally closes its contacts 215. The closing of extension period cam 213 contacts 215 closes a circuit to selector motor 67 which is traceable from the alternating current source AC, through wires 71, 246, extension period cam contacts 215, wires 247 and 223, closed contacts 216 of initial period cam 214, contacts 224 of timing motor cam 225, wire 227 to magnet 114 and wire 83 back to the alternating current source AC. Magnet 114 closes the selector switch motor 67 circuit through contacts 117 and the selector is moved to fourth position.

If there are no actuations of the vehicle detectors 500 or 500' on No. 2 or No. 4 streets, say after the second one, when six are allowed by the setting of extension period crank handle 230, and before timing motor cam 225 completes the circuit to selector switch motor 67 through contacts 216 and 224, the selector switch is moved to fourth position, and control of the signal system is taken from No. 2 and No. 4 streets for the remainder of the signal cycle. That is to say, there can be no more extension period units for No. 2 or No. 4 street traffic, selector switch 65 having disabled the extension mechanism by opening contacts 17.

When contacts 17 open, the initial period and extension period mechanism is reset by the resulting deenergization of pawl magnet 208, so that pawl 210 drops from ratchet wheel 211 and spring 240 (Fig. 4), rotates cams 213 and 214 to their initial positions, opening contacts 215 and 216. Also, during the last addition to the extension period, timing motor cam 89 opened contacts 110 to reset No. 2 memory relay 100.

SELECTOR SWITCH FOURTH POSITION

It will be recalled that in the third position of the selector switch, No. 1 or No. 3 street vehicular traffic or pedestrian traffic could not assume control of the system, although following traffic in streets No. 2 and No. 4 could set up the extension period and maintain the system in the third position. In the fourth position of the selector switch, extension periods cannot be set up to extend the right of way period for the No. 2 and No. 4 streets, but pedestrian and No. 1 and No. 3 street traffic can assume control.

Assume that, some time during the time that the right of way was transferred to No. 2 and No. 4 street traffic and maintained thereby during the extension period, traffic on No. 1 and No. 3 streets set up the remembering period by energizing No. 1 memory relay 80 in the manner previously described, the holding circuit thereof being completed through closed selector switch contact 9, which, as indicated in the foregoing table, remains closed for practically all positions of the selector. At the end of the initial period for No. 2 or No. 4 streets, if there are no following units of traffic to set up the extension period, or at the end of the extension period, or at the end of some fractional part of the extension period when there is no following traffic to accept the remainder of the full extension period allowed, No. 1 memory relay 80 assumes control of certain circuits set up for it by the selector switch 65. One of these circuits includes selector contact 2 and may be traced from the alternating current source AC, wires 71 and 105, pigtail 84', armature 84 of memory relay 80, contacts 85, wire 93,

closed switch 640, wire 93', selector contact 2, magnet 114 and back to the alternating current source AC by wire 83. Magnet 114 closes the circuit of selector motor 67 and the switch is moved to fifth position.

It will be observed from the foregoing that, during the fourth position of selector switch 65, No. 2 and No. 4 street traffic still has the right of way in order to permit the traffic last crossing the vehicle detectors 500 and 500' to clear the intersection before the signal lights turned against it, the circuits for these lights G—2, G—4 and R—1, R—3 being maintained through closed selector contacts 18 and 19.

SELECTOR SWITCH FIFTH POSITION

In this position of the selector switch, contacts 18 are open and No. 2 and No. 4 street green lights G—2 and G—4 are extinguished, but No. 1 and No. 3 street red lights R—1 and R—3 remain lighted through selector contacts 19, which remain closed.

The closing of selector contacts 16 energizes amber light relays 122 and 123 through a circuit traceable from the alternating current source AC, wires 71, 105 and 165, back contacts of relays 150 and 151, wire 248, selector contacts 16, wires 249, parallel relays 122 and 123 and back to the alternating current source AC by wires 82 and 83. The holding circuit for these relays is completed from the alternating current source AC, wires 71 and 105, pigtail 120, armature 124, contacts 126', wire 250, terminal 253 where the circuit divides, one branch following closed contacts 251 of amber light timing motor 156, wire 252, relays 122 and 123 and wires 82 and 83 to the alternating current source AC. The other branch from terminal 253 leads to amber light motor 156 and to the alternating current source AC by wires 254 and 83. The motor 156 accordingly begins to rotate.

The closing of relay 123 completes a circuit traceable from the alternating current source AC, wires 71 and 105, pigtail 121, armature 125 of relay 123, front contacts 188, wire 255, terminal 256, where the circuit divides, one shunt following wire 257 to relay contacts 258 and 259 to A—2 and A—4 lights and back to the alternating current source AC by wire 135. The other shunt, through terminal 256, traverses live wires 71 and 105, the closed back contacts of relays 150 and 151, wire 248, closed selector contacts 20, terminal 256 and the A—2 and A—4 lights. Accordingly, the signal lights facing No. 2 and No. 4 street traffic change from green to amber.

The closing of contacts 6 of selector switch 65 completes a circuit traceable from the alternating current source AC by wires 71 and 105 to pigtail 260, back contacts 261 of pedestrian relay 262, wire 263, closed selector contacts 6, magnet 114 and wire 83 back to the alternating current source AC. Magnet 114 closes contacts 117 to actuate motor 67, which moves selector switch 65 to sixth position.

SELECTOR SWITCH SIXTH POSITION

In this selector switch position No. 1 and No. 3 street red lights R—1, R—3, and No. 2 and No. 4 amber lights A—2, A—4 remain illuminated because the corresponding selector contacts 19 and 20, respectively, remain closed. The amber light motor 156 is still rotating, and relays 122 and 123 remaining closed.

The selector switch 65 immediately moves to seventh position, the circuit to its motor 67 being traceable from the alternating current source AC, wires 71 and 105, pigtail 120, armature 124 of closed relay 122, front contact 126', wire 166, closed contacts 169 of cam 168 of amber motor 156, wire 170, closed selector contacts 4, magnet 114 and wire 83 back to the alternating current source AC. Magnet 114 closes selector motor 67 circuit and the motor rotates selector switch to seventh position.

SELECTOR SWITCH SEVENTH POSITION

In this position of the selector switch, streets No. 1 and No. 3 receive the red "stop" signal through selector contact 19 and the amber lights A—2 and A—4 remain energized through contacts 188 of relay 123 and the amber light motor 156 continues to rotate.

The left-hand cam 168 of amber motor 156 momentarily closes contacts 186, completing a circuit traceable from the alternating current source AC by wires 71 and 105, pigtail 120, armature 124 of relay 122, which is still closed, its front contact 126', wire 166, contacts 186 of amber motor cam 168, wire 187, closed selector contacts 7, selector motor magnet 114 and back to the alternating current source AC by wire 83. Magnet 114 completes selector motor 67 circuit and selector switch 65 is moved to eighth position. This completes the amber light period on streets Nos. 2 and 4.

SELECTOR SWITCH EIGHTH POSITION

In the position of the selector switch, the right of way is given to No. 1 and No. 3 street vehicular traffic by the energization of the corresponding green lights G—1 and G—3 through closed selector contacts 23, while illumination of No. 2 and No. 4 street red lights R—2 and R—4 is established through closed selector contacts 22. Amber motor 156 has completed its revolution, opening its contacts 251 with cam 155 to break its own circuit and the holding circuit of relays 122 and 123, which are accordingly reset.

Closure of selector contacts 24 initiates the circuit of timing motor 202, the circuit being completed by the back contacts of relay 122 when the latter is reset by amber motor cam 155 in the manner just described. This timing motor 202 circuit is traced from live back contacts 126 of relay 122 through wires 128 and 129 to closed selector contacts 24 and by wire 350 to magnet 351 of the No. 1 and No. 3 street right of way timer counting mechanism and to timing motor 202 which begins to rotate. Magnet 351 pulls its pawl 352 into engagement with ratchet wheel 353 to hold the latter in any position to which it is advanced step-by-step by pawl or star wheel 217 on timing motor shaft 218.

This sets up the initial period for the No. 1 and No. 3 street vehicular traffic right of way, the minimum duration of which is predetermined by the setting of initial period cam 354, which is set in the same way that the initial period cam 214 for No. 2 and No. 4 streets was set. In fact, the timing mechanism for both sets of streets is identical, being illustrated in detail in Figure 4, and therefore it need not be described again. Suffice to say that, at the end of the initial period, if no extension period is set up, initial period cam 354 closes its contacts 355 to prepare the selector moto 67 circuit, which is completed by the closing of contacts 224 by cam 225 on timing motor shaft 218. This circuit may be traced from closed back contacts 86 of No. 1 memory relay 80 through closed selector contacts 11, initial period contacts 355, timing motor cam 225, contacts 224, and mag-

net 114, which energizes selector motor 67 to move the selector switch 65 back to first position.

If an extension period of the right of way for No. 1 and No. 3 streets is initiated by a following vehicle No. 1 memory relay 80 is closed, and the circuit to selector motor 67, just traced, is broken and remains open until the memory relay is reset by opening of its holding circuit by cam 89, contacts 90, whereupon selector motor 67 advances when cam 225 contacts 224 are closed, unless all allowed units of time for the extension period are called for, whereupon extension period cam 358 closes contacts 359 to establish a circuit directly from the alternating current source AC by wires 71 and 246, extension period cam 358, closed contacts 359, initial period cam 354, closed contacts 355, timing motor cam 225, contacts 224, and wire 227 to magnet 114, which starts the selector motor to move selector switch 65 to first position. The cycle is then ready to be repeated in the manner described, it being observed that No. 1 and No. 3 streets still have the normal right of way, the lights not having changed as the selector switch moved from eighth back to first position.

The foregoing describes certain typical sequences of operation of the system of this invention when it is arranged to be "fully actuated"; that is, controllable by vehicular traffic upon any of the streets approaching the intersection to appropriate the right of way from some other street and keep it until appropriated by traffic on still another street. After the right of way has been maintained on one street, say No. 1 and No. 3, throughout the initial period and any extension period that may be required, this right of way still remains on such street provided no approaching vehicle on No. 2 and No. 4 streets, or pedestrian, appropriates control. With the system in this condition, a following vehicle approaching on No. 1 and No. 3 streets may pass the intersection without effect upon the signaling system. If a vehicle approaches on cross streets No. 2 and No. 4, actuation of the corresponding street contacts 500 or 500' results in the initiation of a signal cycle which changes the signal from green on No. 1 and No. 3 streets to amber and then to red, and changes the signals from red on No. 2 and 4 streets to green. Thus the vehicle on No. 2 or No. 4 street can proceed across the intersection and traffic on No. 1 and No. 3 streets is halted by the red lights R—1 and R—3. The right of way remains with No. 2 and No. 4 streets throughout the initial period determined by the initial period cam 214. During the first portion of this initial period, following traffic on No. 2 or No. 4 streets has no effect on the period during which the right of way is maintained on these streets. However, during the last portion of this initial period, represented by that part of the last rotation of timing motor shaft 218 after contacts 90 and 110 have been opened and reclosed, but before contacts 224 have been closed, a following vehicle on No. 2 or No. 4 street may set up a unit extension period. During the last portion of each of such unit extension periods, following vehicles may similarly set up additional unit extension periods until all further extensions are exhausted by the running out of cam 213 and closing of contacts 215. Thereafter, streets No. 2 and No. 4 still maintain the right of way if no opposing traffic approaches and if no pedestrian actuates a detector to appropriate the right of way. During the initial and extension periods, right of way cannot be appropriated by opposing traffic or by a pedestrian.

In order to make the system "semi-actuated", that is, with one or more streets having the normal right of way, which may be appropriated by a vehicle approaching on another street for a period sufficient to allow it to negotiate the intersection before the right of way is restored to the first street, it is only necessary to close either one of the switches 370 or 371, depending upon which street is to have the normal right of way or "normal go".

Thus, if vehicular traffic on No. 1 and No. 3 streets is to have the normal right of way, switch 371 is closed. This short-circuits the vehicle detectors and holds No. 1 memory relay 80 closed. With this condition No. 1 and No. 3 street vehicular traffic has the right of way unless and until it is appropriated by No. 2 and No. 4 street vehicular traffic or pedestrian traffic, but the right of way always returns to No. 1 and No. 3 street vehicular traffic at the completion of the No. 2 and No. 4 street cycle or the pedestrian cycle, because No. 1 memory relay is still closed and reappropriates the right of way.

The same condition for No. 2 and No. 4 streets takes place if switch 370 is closed.

If both switches 370 and 371 are closed, a "prefixed timer" system results, since, in that event, the right of way is alternately and automatically transferred from No. 1 and No. 3 streets to No. 2 and No. 4 streets and vice versa. Thus, beginning with the right of way on No. 1 and No. 3 streets, for example, lights G—1, G—3, R—2 and R—4 remain illuminated for a predetermined period (selector switch eighth and first positions). The signals then change to amber (A—1, A—2) for No. 1 and No. 3 streets, while the red lights (R—2, R—4) remain for No. 2 and No. 4 streets (selector switch second position). The signals change again after a predetermined shorter period to red (R—1, R—3) for No. 1 and No. 3 streets and green (G—2, G—4) for No. 2 and No. 4 streets and remain for a predetermined period to give traffic on No. 2 and No. 4 streets the right of way (selector switch third and fourth positions). The signals change again for a predetermined shorter period to amber (A—2, A—4) for No. 2 and No. 4 streets while red lights (R—1 and R—3) for No. 1 and No. 3 streets remain illuminated (selector switch fifth, sixth and seventh positions). The next signal change restores the right of way to No. 1 and No. 3 streets (G—1, G—3) and holds traffic stopped on No. 2 and No. 4 streets (selector switch eighth and first positions). The signal cycle is then repeated again and again. The time of each of these signal periods is determined by the times at which the timing motor 202, the amber light motor 156, and the pedestrian and all-red motor 314 operate to step the light-controlling selector switch to the various positions indicated.

It will be seen that the vehicular portion of the new system is very flexible in its utility, being selectively adjustable as to timing, operation, and type of system, depending upon requirements. In addition to the vehicular control there is a pedestrian control, which, if rendered operative in cooperation with the vehicular control, permits a pedestrian at any corner of the intersection to appropriate control of the signal system at the proper time for a predetermined but adjustable period of time, so that pedestrian traffic may move with safety in all directions at the intersection. This pedestrian control will now be described.

PEDESTRIAN CONTROL

Located on or adjacent to each of the four corners of the intersection is a pedestrian detector 300 (Fig. 3), comprising a push-button treadle, inductance or capacitive detector, or the like, all of which are connected in series and which, when actuated or otherwise controlled by pedestrian traffic seeking to cross one of the streets of the intersection, breaks the normally closed circuit to pedestrian or P detector relay 301. This detector relay is precisely like No. 1 and No. 2 vehicle detector relays 56 and 560 and therefore need not be described. The operation of P detector relay 301 energizes P memory relay 262 (Fig. 1), which breaks back contacts 261 and bridges front contacts 302 with its armature 303. This relay sets up a holding circuit for itself traceable from the alternating current source AC by wires 71 and 105, pigtail 260, armature 303, front contacts 302, wire 304 to terminal 305 where the circuit divides, one branch following wire 306 to closed contact 10 of selector switch 65, which is usually closed as the table indicates, wire 307, terminals 308 and 309, relay 262, and wires 82 and 83 back to the alternating current source AC. A shunt of this holding circuit leads from aforementioned terminal 305 by wire 311 to closed contacts 312 of cam 313 of pedestrian motor 314, wire 310, terminal 309, P relay 262 and back to the alternating current source AC by wires 82 and 83.

Assuming that the selector switch is in the first position, according to the foregoing table, the other circuit closed by P relay 262 is traceable from the alternating current source AC, wires 71 and 105, pigtail 260, armature 303 of P relay 262, front contacts 302, wire 315, through closed switch 610 to wire 315', closed selector contact 3, wire 113, magnet 114 and back to the alternating current source AC by wire 83. Magnet 114 closes contacts 117 to energize selector motor 67, which moves to second position.

Inasmuch as the several positions of the selector switch have been described in detail, it will not be necessary to repeat the description of the effect of these positions, except where they affect the pedestrian control. Accordingly, it will be recalled that in the second position of the selector switch, the No. 1 and No. 3 street traffic, having previously had the right of way, is warned of a change by energization of A—1 and A—3 amber lights and extinguishing of G—1 and G—3 green lights. These amber lights are controlled by selector contacts 27 which completes the circuit of relays 150 and 151 and amber light motor 156, which accordingly begins to rotate.

From its second position, selector switch 65 rotates practically continuously until it reaches sixth position, where all streets receive amber and red signals as hereinafter described. This is desirable since the vehicular traffic must be stopped to permit pedestrian traffic to cross and therefore the vehicle right of way transferring positions of the selector switch can be skipped, i. e., the third to fifth positions, inclusive.

The sequence of operations performing this skipping action begins with movement of the selector switch 65 from second position, where it made or maintained the circuit of its motor 67 from the alternating current source AC, wires 71 and 105, pigtail 106, closed back contacts 104 of No. 2 memory relay 100, closed selector contacts 5, magnet 114 and back to the alternating current source AC by wire 83. It should be noted that closing this circuit requires the closing of the back contacts 104 of No. 2 memory relay 100, so that if because of the approach of the vehicle on streets No. 2 or No. 4, this relay 100 is energized, the selector switch energizing circuit will not be closed and the operation of the system will be as described above in connection with vehicle actuation. Selector switch 65 accordingly keeps rotating to third position, where closure of its contacts 4 maintains the circuit of its motor from the alternating current source AC, wires 71, 106 and 165, pigtail 164 of closed relay 150, front contact 162, wire 166, closed contacts of cam 168 of amber light motor 160, wire 170, closed contacts 4 of selector switch 65, magnet 114, and back to the alternating current source AC by wire 83.

Selector switch 65 is accordingly rotated to fourth position from which it rotates at once to fifth position because its motor circuit is maintained through front contacts 302 of P relay 262, wire 315, through switch 610 to wire 315', and closed selector contacts 3. In the fifth position, the selector switch contacts 16 are closed but this does not energize the relays 122 and 123 because the relays 150 and 151 are energized. Similarly, the selector switch rotates to sixth position, because at this time, amber light motor 156 completes its rotation and momentarily closes contacts 186, which, through closed selector contacts 7, maintain the selector motor circuit. At the same time, amber light motor 156 breaks its own circuit by opening its contacts 154, which also break the holding circuit of amber light relays 150 and 151, so that they are reset.

In the sixth position of selector switch 65, contacts 25 are closed, establishing a circuit from the alternating current source AC, wires 61 and 105, pigtail 120, closed back contacts of relay 122, wire 129, closed selector contacts 25, wire 316, terminal 317 where the circuit divides, one branch leading by wire 318 to pedestrian motor 314 and to the alternating current source AC, and the other branch leading to magnet 319 and to the alternating current source AC by wires 320, 82 and 83. Magnet 319 pulls its pawl 321 into engagement with ratchet wheel 322 on shaft 323, carrying initial period cam 324 and extension period cam 325, and being driven step-by-step by periodic engagement of its ratchet wheel 322 with star wheel or pawl 326 on the shaft 327 of pedestrian motor 314. The arrangement, construction, purpose and operation of the pedestrian initial and extension period timing mechanism are precisely the same as those described in connection with the No. 2 and No. 4 street vehicular traffic control system previously described in detail and illustrated in Figure 4, and therefore this description need not be repeated except to add that the counting of the initial period time until now begins and is followed by the counting of the extension period time units in accordance with the successive actuation of pedestrian detectors 300 at the proper time.

As indicated in the foregoing table selector contacts 13 are closed and prepare a circuit to initial period cam 324 contacts 328, so that they may cooperate with contacts 330 of pedestrian motor cam 331 at the proper time that the feeling action of the latter finds the contacts 328 closed and completes the circuit to selector motor 67. Accordingly, this circuit is traceable from the alternating current source AC, wires 71 and 105, back contacts 261 of P relay 262, which are

closed if there is no extension period set up, wires 263 and 332, closed selector contacts 13, wire 333, pedestrian initial period cam 324 contacts 328, wires 334 and 227 to selector motor magnet 114, which accordingly closes the selector motor 67 circuit to rotate the selector switch.

If there is an extension period, the circuit is traced from the alternating current source AC by wires 71, 105 and 335, contacts 329 of extension period cam 325, contacts 328 of initial period cam 324, contacts 330 of pedestrian motor cam 331, and wires 334 and 227 to selector motor 67 which accordingly rotates selector switch 65 to seventh position.

As in the case of the vehicular traffic timing mechanism, the pedestrian motor resets pedestrian P memory relay 262 prior to the end of the initial period and prior to the end of each unit of time of the extension period by breaking the contacts 312 with cam 313 which opens the holding circuit of the relay. In the sixth position of the selector switch, under pedestrian control the red stop lights R—1, R—2, R—3, R—4 for all streets and the amber warning lights A—1, A—2, A—3, A—4 for all streets are simultaneously illuminated, the red light through closed selector contacts 19 and 22 in conjunction with back contacts of relays 150, 151 and relays 122 and 123 respectively and the amber lights through closed selector contacts 20 and 21 in conjunction with back contacts of relays 150, 151 and relays 122 and 123 respectively.

As the selector switch 65 moves to seventh position, it closes contacts 26, which reclose the circuit of motor 314, through its upper winding, the circuit to motor 314 through its lower winding having been broken by the opening of selector contact 25. The opening of selector contact 25 also deenergizes magnet 319 and the closing of selector contact 26 energizes magnet 339. The circuit is traceable from the alternating current source AC, wires 71 and 105, pigtail 120, closed back contacts of relay 122, wires 128 and 129, closed selector contacts 26, wire 336, terminal 337 where the circuit divides, one branch following wire 338 to magnet 339 and motor 314 and the other branch leading to open contacts 340 of cam 341. Magnet 339 pulls pawl 342 into engagement with ratchet wheel 343 on shaft 344 carrying cam 345 controlling contacts 346. Shaft 344 and cam 345 are rotated by star wheel or pawl 326 on motor shaft 343.

In the seventh position of the selector switch 65, the red lights for all streets are illuminated through closed selector contacts 19 and 22 and the back contacts of relays 150, 151 and relays 122, 123 respectively, and the duration of their illumination is determined by the cam 345, and allows pedestrians ample time to cross, while all vehicular traffic is halted. The cam 345 is adjustable in the same way that the cams of the counting mechanism of the vehicular traffic control systems are adjusted, and controls the period during which the traffic lights are all red. As in the other arrangements mentioned, upon closing of the contacts 346 by cam 345 at the end of the predetermined "all-red" period, a circuit is completed from the alternating current source AC by wires 71, 105, 335 and 347, contacts 346, wire 348, contacts 330 when they are closed by cam 331, and wires 334 and 227 to selector motor 67, which accordingly rotates to eighth position.

In the eighth position of selector switch 65, the right of way is restored to No. 1 and No. 3 street vehicular traffic, from which it was appropriated by the pedestrian control. Thus, green lights G—1 and G—3 are lighted through closed selector contacts 23, while the illumination of R—2 and R—4 red lights for No. 2 and No. 4 street vehicular traffic is maintained through closed selector contacts 22.

The duration of the No. 1 and No. 3 street right of way is determined by timing motor 202 which is energized through closed selector contacts 24 by a circuit traceable from the alternating current source AC, wires 71 and 105, closed back contacts of relays 122 and 123, wire 129, closed selector contacts 24, wire 350, pawl magnet 351 and timing motor 202 back to the alternating current source AC. The motor 202 begins to rotate, pawl 352 engaging the ratchet wheel 353 to hold it in the positions to which it is indexed by pawl or star wheel 217 on the timing motor shaft 218.

The predetermined initial period is fixed by initial period cam 354 in the manner described in connection with the other timing devices, closing contacts 355 at the end of its travel, so that cam 225 of timing motor 202 may close contacts 224 to complete the circuit to the selector motor 67. This circuit is traced from the alternating current source AC, wires 71 and 105, closed back contacts 86 of No. 1 memory relay 80, wire 356, closed selector contacts 11, wire 357, closed contacts 355 of initial period cam 354, contacts 224 of timing motor cam 225, wires 226 and 227 to magnet 114 and back to the alternating current source AC. The selector accordingly rotates to first position, unless an extension period is set up at the proper time, i. e., after contacts 90 open and close and before timing motor cam 225 contacts 224 close to complete the selector motor circuit. This is accomplished by energization of No. 1 memory relay 80 by a vehicle engaging detector 50 or 50', and breaks the circuit just described through selector contacts 11 by breaking its feed through back contacts 86 of No. 1 memory relay 80.

As was previously described, the extension period cams determine the duration of the extension period, and extension period cam 358 controlling contacts 359 for No. 1 and No. 3 street vehicular traffic operates in the same way and need not be further described.

It will be seen that the pedestrian control actuates the selector switch in a different way than the vehicular control, causing the selector switch to skip such positions as are not required for the pedestrians' signals. This skipping is performed rapidly, but the vehicular traffic is given sufficient time to stop on all streets forming the intersection before the period for pedestrian crossing begins, thus period being predetermined initially by the setting of the initial period cam 324 and being continuable with predetermined limits by the setting up of unit extension periods by the reactuation of pedestrian detectors 300 at the proper times by following pedestrians. These proper times are determined jointly by initial period cam contacts 328, pedestrian motor cam contacts 330 and 312, in the manner previously described, pedestrian traffic being incapable of setting up unit extension periods at other times. The extension period cam 325 controls with its contacts 329 the limit of the extension period in accordance with the presetting of cam 325.

If, for any reason, it is desirable to give the pedestrians the "normal walk" signal, switch

373 is closed, short-circuiting pedestrian detectors 300, so that P memory relay 262 remains energized. It will be understood that at the end of each particular traffic cycle the system will be restored to all red and amber condition with R—1, R—2, R—3, R—4, A—1, A—2, A—3 and A—4 lights illuminated, just as though a pedestrian held one of contacts 300 open continuously.

It should be noted that the traffic lights energized in the sixth and seventh position of the selector switch differ depending on whether the control is set up by a vehicle or a pedestrian. Thus, the sixth position, whereas under vehicle control the lights R—1 and R—3 and A—2 and A—4 are lighted, under pedestrian control, all of the red and amber lights are energized. Also in the seventh position, whereas under vehicle control the lights R—1 and R—3 and A—2 and A—4 were energized, under pedestrian control, all red lights are energized. This difference in operation between vehicular and pedestrian control is due to the fact that in positions six and seven, under vehicular control, amber light relays 122 and 123 are in their energized positions, whereas under pedestrian control in these positions, these relays are in their deenergized positions.

Considering conflicting endeavors to appropriate control, if with the selector switch in the first position, a pedestrian and a vehicle on streets No. 2 and No. 4, for example, simultaneously actuate their detector devices, the vehicle will have precedence and the selector switch will continue to its third position giving the vehicle right of way. However, at the same time, pedestrian memory relay 262 will be energized and at the termination of the initial and all required extension periods of right of way on streets No. 2 or No. 4, right of way will be accorded to the pedestrian and the selector switch will continue to the sixth position. Considering a conflict of a pedestrian and a vehicle with the selector switch in the fourth position, in this case if a pedestrian and a vehicle on streets No. 1 or No. 3, for example, simultaneously actuate detectors, the pedestrian will take precedence and the selector switch will continue to the sixth position, the No. 1 and No. 3 street memory relay 100 being maintained energized and appropriating right of way to streets No. 1 and No. 3 after the termination of the pedestrian interval. This means that when a conflict occurs, the system accords right of way to either the pedestrian or the vehicle depending upon which position the selector switch may occupy at the time the conflict arises.

Also, while the pedestrian control has been described as an integral part of the traffic regulating system of this invention, it may form a separate unit if desired, since it is independently operative.

Time Control Mechanism

The foregoing describes the construction and operation of that part of the traffic control unit of this invention which provides for the operation of the traffic signalling devices in accordance with the actual volume and nature of the traffic at the particular intersection where the unit or system is located, subject only to the limitation imposed by the extension period mechanisms which limit the number of extension periods for through lane, cross street and pedestrian traffic. However, in cases where a plurality of traffic control units are to be used along the course of a through traffic lane, as at successive intersections thereof by cross streets, it is desirable that each of the units be operable in a predetermined time phase relative to the other units in order that traffic on the through lane may negotiate the successive intersections according to a predetermined plan. The mechanism by which the new traffic control unit is made to operate in a predetermined time phase, whereby a plurality of the units may be synchronized, will now be described.

The switch 605, as previously described, completes the motor circuit of selector switch 65 through closed contact 1 when the selector switch is in its first position and the No. 2 memory relay is closed, the circuit being traceable from the AC source through wires 71 and 105, pigtail 106, memory relay armature 102, relay contact 103, wire 112, switch 605, wire 112', closed contact 1 of selector switch 65, wire 113, relay 114, and wires 115 and 83 back to the AC source. Connected to the terminals of switch 605 are wires 601 and 602, respectively, which lead to normally open contacts 603, the contacts being controlled by a cam 604 mounted on a shaft 606 driven by a constant speed motor 607. The motor 607 may be of the electrically-driven synchronous type and is connected to a suitable source of current, such as 110-volt lighting current conveniently obtained from supply line 608. Accordingly, when the switch 605 is opened, cam actuated contacts 603 are connected into the selector switch motor circuit just traced, in place of switch 605, and the circuit will not be completed until the constant speed motor 607 moves cam 604 to a position for closing the contacts.

Similarly, the switch 610, which as previously described completes the selector switch motor circuit through closed contact 3 when the selector switch is in its first position and pedestrian memory relay P is closed, is connected through wires 611 and 612 to normally open contacts 613. Contacts 613 are adapted to be closed at predetermined time intervals by a cam 614 which is preferably mounted on the shaft 606 driven by constant speed motor 607. It will be apparent that when switch 610 is opened, contacts 613 will be connected into the selector switch motor circuit including closed contact 3 and P memory relay, in place of switch 610, the circuit being now traceable from the AC source through wires 71 and 105, pigtail 260, armature 203 of P relay 262, front contacts 302, wires 315 and 611, contacts 613, wires 612 and 315' closed selector contact 3, wire 113, relay 114, and wires 115 and 83 back to the AC source. Accordingly, the circuit just traced will always remain open until such times as the constant speed motor 607 moves cam 614 into position for closing the contacts 613.

Connected to wire 223 which leads to extension and initial period contacts 215 and 216, respectively, is a wire 223' leading to one terminal of contacts 615. The other terminal of contacts 615 is connected by wires 616 and 617 to the positive side of the AC current source. Contacts 615 are adapted to be closed at regular intervals by cam 618 mounted on cam shaft 606. Thus, when cam 618 closes its contacts 615, current will be supplied from the AC source through wires 617, 616, contacts 615 and wire 223' to the wire 223. Closure of contacts 615 is effective only when the selector switch is in the third position, because it is in this position that extension and initial period cams 213 and 214, respectively, op-

erate to set up initial and extension periods for cross street traffic. Assuming that the selector switch is in the third position and that the initial period has ended so that contacts 216 are closed, closure of contacts 615 by cam 618 will prepare a circuit through the selector motor switch 114, which will be completed upon closing of contacts 224, thereby causing the switch to move to the fourth position. The circuit to the selector motor switch is traced from wire 223' through wire 223, contacts 216 and 224, wires 226 and 227 to electromagnet 114 which is connected to the negative side of the AC source through wire 83. Thus, assuming that the selector switch is in the third position wherein initial and extension period cams 214 and 213 are operated, when the initial period is terminated by cam 214, closure of contacts 615 will move the selector switch into the fourth position upon closure of contact 224, regardless of whether there is sufficient traffic on the cross street to set up additional extension periods.

Connected to wire 357 which leads to initial and extension period contacts 355 and 359, respectively, for the through lane, is a wire 357' leading to one terminal of contacts 620. The other terminal of contacts 620 is connected by wires 621 and 617 to the positive side of the AC source. Contacts 620 are adapted to be closed at regular intervals by a cam 622 mounted on cam shaft 606, the closure of these contacts supplying current to wire 357 through wires 617, 621, contacts 620 and wire 357'. It will be observed that when the selector switch is in the eighth position wherein the initial and extension period cams for the through lane are in operation, closure of contacts 620 will cause the selector switch to move into its first position, assuming that the initial period determined by cam 354 has terminated, regardless of whether traffic on the through lane continues to maintain memory relay No. 1 in its closed position. Current for operating the selector motor switch 114 to move the selector switch to the first position will be supplied from wire 357' through contacts 355 and 224, and wires 226 and 227.

Referring to the pedestrian traffic timing mechanism, a wire 333' is connected to wire 333 which leads to the initial and extension period contacts 328 and 329, respectively. Wire 333' leads to one terminal of contact 630, the other terminal of which is connected through wires 631 and 617 to the positive side of the AC source. A cam 632 is mounted on cam shaft 606 and is arranged to close contacts 630 at regular time intervals. Closure of contacts 630 supplies current to wire 333 from the AC source through wires 617 and 631, contacts 630 and wire 333'. Thus, when the initial period for pedestrian traffic has terminated and contacts 328 have closed, closure of contacts 630 will cause the selector switch to move from the sixth to the seventh position immediately upon closing of contacts 330, regardless of whether the pedestrian memory relay is still closed. This is so because closure of contacts 630 supplies current to the selector motor switch 114 through wire 333', contacts 328 and 330 and wires 334 and 227.

Connected to the terminals of switch 640 are wires 641 and 642, respectively, which lead to normally opened contacts 643, these contacts being controlled by cam 644 mounted on cam shaft 606. Cam 644 is arranged to close its contacts at regular time intervals and maintain them in a closed position for a predetermined period of time. It will be recalled that switch 640 in its closed position is in the circuit which includes selector switch contact 2, the latter being the contact through which selector motor switch 114 is energized when the selector switch is in the fourth position. Accordingly, when switch 640 is opened, contacts 643 will be included in the circuit for moving the selector switch from the fourth position, and if the selector switch should move into the fourth position before contacts 643 are closed it will be compelled to remain in that position until contacts 643 close.

It will be apparent from the foregoing that when switches 605 and 610 are opened, cams 604 and 614 of the time-controlled mechanism serve to prevent movement of the selector switch from its first position with resultant appropriation of the right of way from the through lane until a predetermined time after the beginning of the normal cycle on the through lane, that is, until cams 604 and 614 close their respective contacts. Also, when switch 640 is opened, the time-controlled mechanism serves to prevent movement of the selector switch from its fourth position with resultant appropriation of right of way from the cross street, until a predetermined time in the cycle of the unit, that is, until cam 644 closes its contact. Cams 618 and 632 serve to terminate the extension period for cross street and pedestrian traffic respectively at predetermined points in the cycle, in the event that such extension periods are in progress when the cams close their respective contacts. In practice, cam 618 is arranged to close its contacts before cam 632 closes its contacts, so that pedestrian right of way may always be accorded in every cycle for at least substantially all of the period between closing of contacts 615 by cam 618 and closing of contacts 630 by cam 632. Upon closing of contacts 630, which is arranged to take place after the initial period for pedestrians, the selector switch will immediately move from the sixth to the eighth position and being a new cycle, assuming that No. 1 memory relay is closed. Thus, closure of contacts 630 will mark the beginning of a new cycle, that is, will mark the time at which the selector switch moves to the eighth position to return right of way to waiting traffic on the through lane. In the event that extension periods for the through lane are in progress when cam 622 closes its contacts, the selector switch will move immediately upon closing of contacts 620 to the first position and then to the third position to accord right of way to cross street traffic, assuming that such traffic has closed No. 2 memory relay.

Within the limits outlined above, however, the traffic control unit is free to operate in the usual manner according to the nature and volume of traffic at the intersection. That is, if there is no traffic waiting to negotiate the intersection when the selector switch moves into one of its rest positions, i. e., its first or fourth position, the selector switch will remain in its rest position and continue to accord right of way to the street on which the extension period has just terminated. Also, the selector switch is free to move from its third, sixth or eighth positions wherein extension periods are set up for cross street, pedestrian and through lane traffic respectively, at any time after termination of the initial period and before cams 618, 632 and 622 respectively, close their respective contacts. Thus, assuming that the selector switch is in the eighth position wherein right of way is accorded to the through streets Nos. 1 and 3, the switch will remain in this position until the end of the initial period,

or, if traffic on the through lane sets up extension periods, until the end of the last extension period, whereupon it will move to the first position in the usual manner, as described. However, if the initial period for the through lane does not start until some time after the beginning of the normal cycle so that extension periods are in progress when cam 622 closes its contacts, closure of the latter contacts will move the switch to its first position even though the maximum number of extension periods have not elapsed. If neither cross street memory relay 100 nor pedestrian memory relay 262 has been closed in response to corresponding traffic, the selector switch will remain in the first position, thereby continuing right of way to the through lane, until one of the relays is energized. However, closing of either the cross street or pedestrian memory relays will not energize the selector motor 67 unless and until one of the time-controlled contacts 603 and 613, in circuit with the closed contacts of its corresponding memory relay, is closed. When this occurs, the selector motor will be energized by one of the circuits previously traced, including selector contacts 1 and 3, and the selector switch will move into the second position.

The selector switch 65 passes through the second position in the manner previously described and upon reaching the third position, assuming that a traffic unit on the cross streets has energized No. 2 memory relay, accords the right of way to No. 2 and No. 4 streets and sets the initial and extension period mechanisms for these streets into operation. Regardless of other conditions, right of way will be maintained on the cross street for the initial period determined by cam 354. Upon closure of initial period contacts 355 right of way may be continued on the cross street by actuation of the extension period mechanism by following traffic, but right of way will be terminated by closure of extension period contacts 359 and will be terminated before closure of these contacts if cam 622 should first close its contacts, which would be the case if the initial period for cross street traffic were to begin later than the usual point in the cycle. If following traffic on the cross street fails to set up extension periods, the selector switch will move to the fourth position in the usual manner, but will be prevented from moving into the fifth position until cam 644 has closed its contacts. When contacts 643 close with the selector switch in the fourth position, the switch will immediately move to the fifth position providing that either the pedestrian or through lane memory relay is energized, and if neither of these relays are energized, the switch will remain in the fourth position until such energizing occurs.

The selector switch passes through the fifth position in the manner previously described and upon reaching the sixth position, assuming that a pedestrian has energized the pedestrian memory relay, accords the right of way to pedestrian traffic and sets the initial and extension period mechanism for such traffic into operation. Regardless of other conditions, right of way is accorded pedestrians for the initial period determined by cam 324. Thereafter, the selector switch will move to the seventh position upon closure of pedestrian extension period contacts 329, closure of time-controlled contacts 630, or failure of pedestrian traffic to set up additional extension periods, whichever occurs first.

The selector switch will pass through the seventh position in the usual manner and return to the eighth position where right or way will again be accorded to the through lane and a new cycle will begin.

It will be observed that with the new traffic control unit the time-controlled cams 618 and 632 may be adjusted relative to time-controlled cams 604 and 614 to assure the return of right of way to traffic on through streets 1 and 3 at any predetermined time after closing of contacts 603 and 613 and appropriation of the right of way, from the through streets, and cams 604 and 614, assure the right of way to waiting traffic on the through lane for a predetermined period regardless of other conditions. Also, the time-controlled cams 604, 614, 618, 622, 632 and 644, while permitting operation of the unit in accordance with the actual volume and nature of traffic within the limits referred to, assure the operation of the unit in a predetermined fixed time phase, whereby several of the units placed along a through lane may be operated either synchronously or progressively as determined by the relative position of their respective time-controlled cams. Thus, by adjusting the cams 604 and 614 on a plurality of the units so that they will all operate simultaneously to close their respective contacts at predetermined time intervals, as determined by the respective constant speed motors 607, the right of way will be maintained along the through lane simultaneously by the units at successful intersections thereof and will not be appropriated from the through lane until a predetermined time, and by adjusting the cams 618 and 632 on the units so that they close their respective contacts simultaneously, the right of way will be returned to the through lane at successive intersections thereof at substantially the same time if it has not already returned thereto, independently of the time-controlled mechanism. By adjusting cams 622 of the units to close their respective contacts simultaneously, the extension periods for the through lane at successive intersections will terminate at the same time thereby permitting transfer of the right of way to the successive cross streets at substantially the same time, and by adjusting cams 644 of the respective units to maintain their contacts closed over co-extensive periods of time, right of way for traffic on successive cross streets may be assured over co-extensive periods of time. Obviously, by adjusting the time-controlled cams of the several units along the lane to close their respective contacts at different times, the units may be made to operate progressively along the lane, or the like.

In order to point out more clearly the advantages of the new traffic control unit, I have shown in Fig. 5 a typical traffic flow diagram representing the flow of traffic under various traffic conditions along a through lane X provided with a control unit T of the present invention at each of the intersections thereof formed by cross streets A, B, C, D, E and F. The time control mechanisms, operated by motors 607 of the respective units, are adjusted to operate progressively along lane X, starting from street A. Referring to Fig. 5, the ordinate of the diagram represents distance along lane X as shown at the left of the diagram, and the abscissae represents time in seconds. The lines *a*, *b*, *c*, *d* and *e* represent the beginning of new cycles of the units along the lane, that is, the time at which the cams of the time control mechanisms of the respective units close their contacts 624 to assure

the transfer of right of way to waiting traffic on the through lane. Thus, the first cycle, which is represented by the space between lines *a* and *b*, begins at A street at zero, at B street at approximately thirty seconds, at C street at approximately sixty-five seconds, at D street at ninety-three seconds, etc. The duration of each cycle, which is determined by the time required for shaft **606** to make a complete revolution, is shown as seventy seconds, and accordingly the beginning of the second cycle at each cross street occurs seventy seconds after the beginning of the first cycle at that street. For simplicity, the amber light periods and pedestrian right of way periods are not included in the cycle, and accordingly the normal cycle will begin with the closing of contacts **615** by cam **618**, which assures movement of the selector switch to the eighth position to accord right of way to waiting traffic on the through lane. However, the operation of the system with these periods will be apparent from the following description.

In the following description it is assumed that cam **604** closes its contacts twenty-five seconds after the beginning of the normal cycle, and maintains them closed for approximately thirty-five seconds, that is for approximately sixty seconds after the beginning of the normal cycle. Cam **618** closes its contacts at the beginning of the normal cycle, while cam **644** closes its contacts approximately sixty seconds after the beginning of the normal cycle and maintains them closed until approximately twenty-five seconds after the beginning of the next cycle, that is, they maintain their contacts closed for a period of approximately thirty-five seconds beginning ten seconds before the end of the normal cycle. Cam **622** is arranged to close its contacts approximately forty seconds after the beginning of the normal cycle. Initial period cam **214** for cross street traffic closes its contacts **216** twenty seconds after operation of the vehicular timing mechanism is initiated, and extension period cam **213** for cross street traffic closes its contacts thirty seconds after the mechanism has started. Initial period cam **354** for through lane traffic closes its contacts thirty seconds after the vehicular timing mechanism is started and extension period cam **358** for through lane traffic closes its contacts forty seconds after the mechanism has started.

Assuming that the selector switch of the unit at A street is moved into its eighth position at zero in Fig. 5 by closing of its contacts **615**, the unit will then accord right of way to the through lane so that waiting traffic on the lane may cross A street and proceed toward B street. If the first vehicle to cross A street proceeds along X lane at a speed determined by the slope of line *a*, it will arrive at B street just as the cam **618** of the unit at B street closes its contact **615** to assure the return of right of way to the through lane. Similarly, the vehicle may proceed along the lane past C, D, E and F streets at a given speed without interruption, the control units at the cross streets operating progressively to accord the right of way as the vehicle approaches the respective streets.

Assuming that heavy traffic follows the first vehicle along the through lane, extension periods will be set up by the following traffic until the maximum number of extension periods permitted by cam **358** of the respective units T have elapsed. As shown in Fig. 5, the through lane extension period cams **358** of the units are arranged to close their contacts **359** forty seconds after the beginning of the initial period for through lane traffic at the respective streets, and accordingly there will be a minimum band of free traffic flow forty seconds wide along the through lane, beginning at zero. That is, for a period of forty seconds beginning at zero, all vehicles negotiating A street will be able to proceed without interruption at a given speed along the through lane past B, C, D, E and F streets. As the last vehicle within the period of forty seconds crosses A street, contacts **359** of the A street unit close and the selector switch of that unit moves into its first position, and similarly the selector switches of the units at B, C, D, E and F streets move into their first positions as the last vehicle passes the respective streets. The first position of the selector switch, it will be recalled, is the position wherein right of way is still accorded to the through lane unless and until waiting cross street traffic has closed memory relay No. 2. It is in this position that timing cam **604** is effective. The latter cam in each unit is adjusted to close contacts **603** twenty-five seconds after the beginning of the cycle, that is, twenty-five seconds after cam **618** has closed contacts **615** to assure return of right of way to the through lane, and the cam **604** maintains its contacts closed for a predetermined time interval for reasons which will presently appear. Thus, under the conditions described, when the selector switches of the units move to their first positions, contacts **603** will be closed and the selector switches will immediately move to their third positions if their respective cross street memory relays No. 2 are closed, and if not, the selector switches will remain in the first position.

If it be assumed that heavy traffic is waiting at cross streets A and B at the end of the maximum free flow period of forty seconds on the through lane, the selector switches of the units at A and B streets will immediately move to their third positions, since their respective contacts **603** will be closed when extension period contacts **359** are closed, whereupon right of way will be accorded to the latter streets. The heavy cross street traffic on these streets will then set up initial and extension periods to the extent permitted by cams **213** of the respective control units, which as shown in Fig. 5 is a period of thirty seconds from the end of the free flow period on the through lane. The period in which traffic on A and B streets is accorded the right of way is designated in Fig. 5 by the area B^1. At the end of the thirty second period, contacts **215** of the respective units are closed by their cams **213** and the selector switch moves to the fourth position. It will be noted that contacts **615** of the respective units are also closed at the end of the thirty second period, because at that time a period of seventy seconds will have elapsed since the first closing of these contacts as shown by lines *a* and *b* and the timing shaft **606** will have made a complete revolution. Accordingly, there will be two independent means assuring movement of the switch to the fourth position. Assuming that traffic is waiting on the through lane, the selector switch then moves immediately to the eighth position where it is ready to start another cycle. Thus, at A and B streets the cycle is made up of a forty second period of free traffic flow on the through lane, and a thirty second period of cross street traffic flow.

At C street, where there is no waiting cross street traffic throughout the first cycle, the se-

lector switch of the corresponding control unit T will remain in its first position and continue to accord right of way to the through lane.

At D street, assuming that heavy cross street traffic appropriates the right of way at the end of the free flow period for the through lane, the maximum number of extension periods will be set up in the same manner as at A and B streets. At the end of the period of thirty seconds permitted by cam 213 of the D street unit, that is, seventy seconds after the beginning of the cycle at D street, the selector switch of the D street unit will move to the fourth position. In this position, assuming that no traffic is waiting on the through lane, the selector switch will remain stationary and continue to accord right of way to cross street D until memory relay No. 1 of the D street unit is closed by approaching traffic on the through lane. In Fig. 5, the area D^1 represents the period of cross street traffic flow at D street in the first cycle, and as there shown the period extends over line *b* into the second cycle where it terminates at approximately six seconds after the beginning of the second cycle. The period is terminated at that time in the usual manner by the approach of a vehicle on X lane, the right of way being appropriated immediately by the through lane traffic.

Referring to E and F streets, the selector switches of the respective control units move in the usual manner into the first position on completion of the free traffic flow period of forty seconds on the through lane. Assuming that no cross street traffic is waiting on E and F streets at this time, the switches will remain in the first position even though contacts 603 of the respective units are closed by their cams, because the switches cannot move until the cross street memory relays are energized. Accordingly, right of way will continue to be accorded to lane X at E and F streets until cross street traffic actuates their corresponding memory relays. When this occurs, right of way will be transferred to the cross streets E and F because cam 604 is formed to maintain its contacts 603 closed for a period of time after completion of the forty second free flow period. However, if no cross street traffic has appeared on E and F streets by the time the first cycle is completed, following traffic on those streets will not immediately effect the respective units because contacts 603 will have opened. The area D^1 represents a period of traffic flow on E and F streets initiated by vehicles on the latter streets approaching X lane approximately ten seconds after completion of the free flow period, the cross street right of way period being extended by following cross street traffic until cams 618 of the respective units close their contacts 615 and move the selector switches to the eighth position for the second cycle.

Considering now the second cycle represented by the space between lines *a* and *b*, the control units at A and B streets, as previously described, will move their selector switches to the eighth position at the beginning of the cycle by closing their respective contacts 615, assuming that traffic is waiting on the through lane at these streets. Right of way will then be accorded to the through lane at A and B streets for the usual period of forty seconds permitted by extension period cam 358, assuming that through lane traffic sets up the maximum number of extension periods. Assuming that no traffic is waiting on streets A and B at the end of the forty second periods for the respective streets, the selector switches of the units at A and B streets will move to and remain in their first positions and continue to accord right of way to the through lane. Assuming that traffic appears on A and B streets and closes memory relays No. 2 of the respective units while contacts 603 of the units are still closed, the selector switches will move to the third position and accord right of way to streets A and B for the remainder of the cycle permitted by cam 618. The period during which right of way is accorded to A and B streets is represented by the area B^2. At the end of the second cycle, cam 618 of the respective units will close their contacts and move the selector switches to the fourth position.

At C street, beginning with the second cycle, the selector switch will continue to remain in the first position regardless of cross street traffic, until contacts 603 close. Assuming that traffic is waiting on the cross street when contacts 603 close, that is, at the end of the period of twenty-five seconds following closure of contacts 615, the selector switch will move into the third position where heavy traffic following the first vehicle on C street will set up extension periods until the end of the thirty-second period permitted by cam 627. Thereupon, the switch will move to the fourth position. Assuming that no traffic is waiting on the through lane, the switch will remain in the fourth position and continue to accord right of way to the cross street for the remainder of the second cycle. The period of cross street traffic flow at C street is represented by the area C^2.

Since no traffic is waiting on the through lane at D street at the end of the first cycle, the selector switch will remain in the fourth position to which it moved upon closing of contacts 615, and will continue to accord right of way to D street, as shown at D^1. Assuming that traffic on the through lane approaches D street approximately six seconds after the beginning of the second cycle at that street, the selector switch will immediately move to the eighth position in the usual manner, since contacts 643 will still be closed at this time. The right of way on C street will accordingly be terminated and transferred to the through lane. Contacts 603 of the D street unit will then close approximately nineteen seconds after right of way is accorded to the through lane. Closing of these contacts, however, will not move the selector switch into the first position, assuming that there is heavy traffic on the through lane, because the extension period mechanism will have six more seconds to complete the twenty-five second period permitted by cam 213. Thirty-one seconds after the beginning of the second cycle at D street, contacts 215 will close and move the selector switch to the first position. Assuming that no traffic approaches on C street during the remainder of the second cycle, the selector switch will remain in the first position and continue to accord right of way to the through lane.

At E street, assuming that heavy traffic is waiting on the through lane at the end of the first cycle, the selector switch will move to the eighth position where right of way is accorded to the through lane, and the through lane traffic will set up the maximum number of extension periods. At the end of the forty second period permitted by extension period cam 358

of the E street unit, the selector switch will move into the first position. Contacts **603** having closed prior to this time and being still closed, waiting traffic on E street will cause the selector switch to move immediately to the third position and the cross street traffic will be permitted to set up extension periods. Assuming that traffic on E street is relatively light and fails to set up sufficient extension periods to utilize the time permitted by cam **618** and extension period cam **213**, the selector switch will move in the usual manner to the fourth position before the end of the second cycle. Since contacts **643** close ten seconds before the end of the cycle the selector switch will then move from the fourth to the eighth position to accord right of way to waiting traffic on the through lane. Thus, the right of way period for E street traffic will be less than the permissible thirty seconds, as shown at E^2.

Traffic conditions at F street in the second cycle are assumed to be similar to those at E street, except that cross street traffic on F street does not set up any extension periods and is accorded only the minimum right of way period of twenty seconds provided by cam **214**. At the end of this period, the selector switch will move to the fourth position, and since contacts **643** close at the end of the twenty second initial period, the switch will then move immediately to the eighth position to accord right of way to waiting traffic on the through lane for the remaining ten seconds of the cycle. The area F^2 represents the right of way period for F street traffic in the second cycle.

Referring to the third cycle represented by the space between lines *c* and *d*, the selector switches of the units at A and B streets move to the fourth position upon closing of contacts **615** of the respective units at the end of the second cycle. Assuming that no traffic approaches the through lane on A or B streets during the second cycle, the selector switches of the respective units will remain in the fourth position and continue to accord right of way to A and B streets, as shown by the area B^3.

At C street, assuming that traffic is waiting on the through lane, the selector switch will move to the eighth position upon closing of contacts **615** at the end of the second cycle and accord right of way to the through lane. After the last extension period on the through lane, the switch will move to the first position where, assuming that no traffic appears on C street during the cycle, it will remain and continue to accord right of way to the through lane.

At D street, assuming that no traffic appears on the cross street during the third cycle, the selector switch will remain in the first position where it was left at the end of the second cycle and will continue to accord right of way to the through lane.

Referring to E and F streets, it will be recalled that the selector switches moved to their eighth positions before completion of the second cycle because traffic on those streets failed to set up sufficient extension periods. Accordingly, the through lane right of way period of forty seconds permitted by cams **358** of the respective units will begin prior to the beginning of the third cycle and end in less than forty seconds after the beginning of the third cycle, even assuming that the maximum number of extension periods are set up by through lane traffic. However, right of way cannot under any conditions be appropriated from the through lane until the expiration of twenty-five seconds from the beginning of the third cycle, because contacts **603** do not close until that time. Assuming that the initial periods for E and F streets terminate within twenty-five seconds after the beginning of the third cycle and that no extension periods are set up, the selector switches of the E and F street units will be in their first positions when contacts **603** close. At that time, that is, twenty-five seconds after the beginning of the cycle, the switches will move to the third position to accord right of way to waiting traffic on the cross streets. Thereafter, assuming that no traffic appears on the through lane at streets E and F, right of way will be accorded to the latter streets throughout the remainder of the cycle, as shown at F^3.

In the fourth cycle, assuming that no traffic appears on the through lane at streets A or B, the selector switches of the respective units will remain in their fourth positions where they were left at the end of the third cycle, and will continue to accord right of way to the cross streets. At the end of the fourth cycle, assuming that traffic appears on the through lane, the selector switches of the respective units on A and B streets will move to their eighth positions and return the right of way to the through lane.

It is assumed that no traffic appears on streets C, D, E and F during the fourth cycle, and accordingly right of way will be accorded to the through lane at these streets throughout the cycle.

For a better understanding of the operating advantages of the traffic control unit of my invention, reference may be had to the following table representing the right of way periods accorded by a typical unit to a main street and a cross street thereof, respectively, under various traffic conditions.

Condition of traffic	First responsive cycle		Further responsive cycle	
	Main street clear	Cross street clear	Main street clear	Cross street clear
1 No cross street traffic	70	0	70	0
2 No main street traffic	0	70	0	70
3 Light cross street and heavy main street traffic	50	20	40	30
4 Light main street and heavy cross street traffic	35	35	35	35
5 Heavy main street and heavy cross street traffic	40	30	40	30
6 Heavy main street traffic starting 5 seconds after beginning of initial period, heavy cross street traffic	35	35	40	30
7 Heavy main street traffic as above (in 6) but starting 24 seconds after beginning of period	25	45	40	30
8 Heavy cross street traffic starting 12 seconds after beginning of initial period, heavy main street traffic	52	18	40	30

In the above table, the first column contains a list of eight different traffic conditions which are assumed to prevail at the intersection. The second and third columns contain figures representing the total time in seconds in which right of way is accorded to the main street and cross street, respectively, in a single cycle under each of the traffic conditions assumed, and the fourth and fifth columns contain figures representing the total time in seconds in which right of way is accorded to the main street and cross street, respectively, in the cycles immediately following the

first cycle under the different traffic conditions assumed. For the purpose of simplicity, the amber light periods and pedestrian right of way periods will be disregarded.

Assuming that each complete cycle of the control unit begins with the closing of contacts **615**, cam **604** of the unit is adjusted to close contacts **603** twenty-five seconds after the beginning of the cycle. Contacts **603** upon closing are maintained closed by cam **604** until approximately sixty seconds after the beginning of the cycle. A complete cycle, that is, the time required for cam shaft **606** to make a complete revolution, is seventy seconds.

Referring to the first traffic condition, in which there is no cross street traffic, the selector switch of the unit will move to the eighth position upon closing of contacts **615**, assuming that there is waiting traffic on the through lane, and will remain in this position until the last extension period for through lane traffic has expired, whereupon it will move to the first position. Since the cross street memory relays are not closed, under the conditions assumed, the selector switch will remain in the first position during the first cycle and further responsive cycles, and continue to accord right of way to the through lane. Accordingly, in each cycle the right of way period for the main street will be seventy seconds, or a complete cycle, and that for the cross street will be zero.

Under the second condition, where there is no traffic on the main street, the selector switch will move to the fourth position upon failure of cross street traffic to set up additional extension periods, or upon closure of extension period contacts **215**, or upon closure of contacts **615**, whichever occurs first. The switch, however, will remain in this position because the main street memory relay is not closed during the first cycle or during further responsive cycles. Accordingly, the unit will continue to accord right of way to the cross street throughout each cycle of seventy seconds and right of way will not be accorded to the main street.

Referring to the third condition in which there is light cross street traffic and heavy main street traffic, closing of contacts **615** will move the selector switch to its eighth position to accord right of way to waiting traffic on the through lane, where extension periods will be set up for through lane traffic to the extent permitted by extension period cam **358** or by time controlled cam **622**, whichever closes its contacts first. The latter cam is adjusted to close its contacts forty seconds after the beginning of the cycle, that is, forty seconds after closing of contacts **615**, and under the conditions assumed it will close its contacts at the same time that cam **358** closes its contacts, since the latter cam closes its contacts forty seconds after beginning of the initial period and the initial period is assumed to have begun at the beginning of the cycle. Upon closing of contacts **359** and **620** the selector switch will move to its third position where right of way is accorded to waiting traffic on the cross street. Thereupon, cam **214** will set up the initial period on the cross street, the cam being adjusted to accord an initial period right of way of twenty seconds. At the end of this initial period of twenty seconds, that is, sixty seconds after the beginning of the cycle, the selector switch will move to its fourth position because of the absence of further traffic on the cross street and failure to set up extension periods thereon. Since contacts **643** close approximately sixty seconds after beginning of the cycle, the selector switch will move immediately to the eighth position and accord right of way to waiting traffic on the main street for the remaining ten seconds of the cycle. Accordingly, the total right of way period for the main street will be fifty seconds and that for the cross street will be twenty seconds in the first cycle. In the second cycle the main street right of way period permitted by extension period cam **358** will terminate thirty seconds after beginning of the cycle, instead of forty seconds, because ten seconds of the period were used at the end of the first cycle. Therefore, thirty seconds after beginning of the second cycle, contacts **603** being closed, the selector switch will move to the third position and accord right of way to waiting traffic on the cross street. Right of way will be accorded to the cross street for the initial period of twenty seconds as in the first cycle, and at the end of the twenty second period, that is, fifty seconds after the beginning of the second cycle, the selector switch will move to its fourth position because of the failure of cross street traffic to set up extension periods. However, the selector switch cannot move immediately to the eighth position because contacts **643** do not close until sixty seconds after beginning of the cycle, and accordingly, the selector switch will necessarily remain in its fourth position and continue to accord right of way to the cross street for an additional ten seconds following completion of the initial period thereon. Upon closure of contacts **643**, that is, sixty seconds after beginning of the second cycle, the selector switch will move to the eighth position and accord right of way to waiting traffic on the main street for the remaining ten seconds of the cycle. Accordingly, the total right of way period for the main street will be forty seconds and that for the cross street will be thirty seconds in the second cycle. Further responsive cycles will be the same as the second cycle.

Under the fourth condition where there is light traffic on the main street and heavy traffic on the cross street, closing of contacts **615** will move the selector switch to its eighth position, and in this position right of way will be accorded to waiting traffic on the main street during the initial period of twenty-five seconds permitted by cam **354**. At the end of this initial period the selector switch will move to its first position, and since contacts **603** are closed at this time the selector switch will move immediately to the third position. In this position right of way will be accorded to the cross street for the initial period of twenty seconds permitted by cam **214**, and heavy traffic will set up extension periods for an additional ten seconds permitted by extension period cam **213**. When the last extension period for the cross street has expired, that is, fifty-five seconds after beginning of the cycle, the selector switch will move to its fourth position. However, the selector switch will be compelled to remain in the fourth position and continue to accord right of way to the cross street for an additional five seconds, that is, until cam **644** closes its contacts **643**. At this time, that is, sixty seconds after beginning of the cycle, the selector switch will move to the eighth position and accord right of way to waiting traffic on the through lane for the remainder of the cycle. Accordingly, the total right of way period for both the through lane and the cross street will be thirty-five seconds in the first cycle. In the second cycle, the initial period for through lane

traffic will terminate fifteen seconds after beginning of the cycle, instead of twenty-five seconds, because ten seconds of the initial period was used at the end of the first cycle. Therefore, fifteen seconds after beginning of the second cycle the selector switch will move to the first position because of the failure of traffic on the through lane to set up extension periods. However, the selector switch will be compelled to remain in the first position and continue to accord right of way to the through lane until cam **604** closes its contacts, that is, until twenty-five seconds after beginning of the second cycle. At this time, the selector switch will move to the third position and accord right of way to the heavy traffic on the cross street for the period of thirty seconds permitted by extension period cam **213**. At the end of this period, that is, fifty-five seconds after beginning of the second cycle the selector switch will move to the fourth position and remain there to accord right of way to the cross street for an additional five seconds, that is, until cam **644** closes its contacts. Thereupon, the selector switch will move to the eighth position and accord right of way to waiting traffic on the through lane for the remainder of the cycle. Thus in the second cycle, as in the first, the total right of way period for both through lane and cross street is thirty-five seconds. Further responsive cycles will be the same as the second cycle.

Referring to the fifth traffic condition in which heavy traffic is on both the main and cross streets, closing of contacts **615** will move the selector switch to its eighth position to accord right of way to waiting traffic on the main street. In this position heavy traffic on the main street will set up the maximum number of extension periods permitted by cam **358**, totalling forty seconds, whereupon cam **622** will close its contacts and the switch will move to its third position and accord right of way to traffic on the cross street. In this position heavy cross street traffic will set up extension periods for the remaining thirty seconds of the cycle, at the end of which time contacts **615** and **215** will close and return the selector switch to the eighth position, and the cycle will be repeated.

Under the sixth traffic condition wherein heavy main street traffic starts five seconds after beginning of the cycle and heavy traffic is on the cross street, closing of contacts **615** will move the selector switch to the fourth position. However, the switch will not immediately move to the eighth position because the main street memory relay has not yet been closed, and accordingly the unit will continue to accord right of way to cross street traffic at the beginning of the cycle until traffic appears on the main street. Under the conditions assumed this occurs five seconds after beginning of the cycle, whereupon the selector switch will move to the eighth position to accord right of way to main street traffic. In the eighth position the usual initial period of twenty-five seconds will be set up and heavy following traffic on the main street will set up extension periods. However, the full number of extension periods permitted by cam **358** will not be set up because cam **622** will close its contacts forty seconds after beginning of the cycle and interrupt the extension periods. Upon closure of contacts **620** by cam **622**, the selector switch will move to the first position and since contacts **603** are closed will move immediately to the third position to accord right of way to the heavy cross street traffic for the period of thirty seconds permitted by cam **213**. At the end of this period, that is, seventy seconds after beginning of the cycle, contacts **615** and **215** will close and the switch will move to the eighth position to return the right of way to waiting traffic on the through lane. Accordingly, in the first cycle the total right of way period for both through lane and cross street traffic will be thirty-five seconds. The second cycle will be the same as the cycles outlined above in the fifth condition.

The seventh condition is the same as the sixth except that the traffic on the main street does not start until twenty-four seconds after the beginning of the cycle. During the twenty-four seconds of the first cycle in which there is no waiting traffic on the through lane, the selector switch will remain in the fourth position and continue to accord right of way to the cross street. Upon the approach of traffic on the main street twenty-four seconds after beginning of the cycle, that is, twenty-four seconds after cam **615** closes its contacts, the main street memory relay will be energized and the selector switch will move to the eighth position, contacts **643** being still closed at this time. In the eighth position right of way will be accorded to the through lane for the initial period of twenty-five seconds permitted by cam **354**. At the end of this time, that is, forty-nine seconds after the beginning of the cycle, initial period contacts **355** will close and since contacts **620** (which were closed by cam **622** forty seconds after beginning of the cycle) are still closed, the selector switch will be energized and will move to the first position regardless of the fact that heavy traffic on the main street is ready to set up extension periods thereon. Since contacts **603** are closed the selector switch will move immediately to the third position and accord right of way to waiting traffic on the cross street for the remaining twenty-one seconds of the cycle. Thus, in the first cycle the total right of way period for the main street is twenty-five seconds and that for the cross street is forty-five seconds. Further responsive cycles will be the same as the cycles outlined above in the fifth condition.

In the eighth condition it is assumed that heavy traffic on the cross street starts twelve seconds after beginning of the normal initial period for the cross street, that is, fifty-two seconds after beginning of the cycle. The cycle will begin upon closing of contacts **615** with resultant movement of the selector switch to the eighth position. In this position heavy cross street traffic accords right of way to the through lane for the period of forty seconds permitted by cam **358**. At the end of this period the selector switch will move to the first position and will remain in this position for an additional twelve seconds, that is, until traffic on the cross street appears. Upon approach of heavy traffic on the cross street, that is, fifty-two seconds after the beginning of the cycle, the cross street memory relay will be energized and the selector switch will move to the third position, contacts **603** being still closed at this time. In the third position right of way will be accorded to the cross street for the remaining eighteen seconds of the cycle, and accordingly, in the first cycle the total right of way period for the through lane will be fifty-two seconds and that for the cross street will be eighteen seconds. Further responsive cycles will

be similar to the cycles outlined in the fifth condition.

It will be seen that the new traffic control unit is extremely flexible in its operation and within the limits imposed by the time-controlled mechanism, automatically adapts itself to the volume and nature of the traffic negotiating the intersection at which it is located. The time-controlled mechanism permits operation of the unit in synchronism with other units without the use of interconnecting means between them, and when a plurality of units are so operated along a through lane, traffic may negotiate successive intersections of the lane according to a predetermined plan. Furthermore, the new unit may be selectively adjusted to provide the exact type of traffic control which local requirements may dictate, as for example, by adjusting switches 370, 371 and 373 the unit may be made to operate as a semi-actuated or pre-fixed timer unit, subject to the influence of the time-controlled mechanism.

I claim:

1. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices, for selectively according right of way to said streets, mechanism for operating said devices, traffic actuable means associated with said mechanism for operating said devices to grant traffic right of way to one of said intersecting streets, means for rendering said first means inoperative at predetermined time intervals, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

2. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, mechanism for operating said devices, traffic responsive means associated with said mechanism for operating said devices to transfer the traffic right of way from one to another of the respective streets, a constant speed driving member, mechanism driven by said member for governing of said transfer of right of way according to a predetermined time schedule, means responsive to traffic in one of the streets for at least partially determining the right of way period accorded thereon by the signal devices, and means operable by pedestrians, for granting special right of way indications for pedestrians intermediate vehicle right of way intervals.

3. In a traffic regulating unit for an intersection of at least two streets, the combination of traffic signal devices for selectively according right of way to said streets, means responsive to traffic on one of the streets for operating said devices to accord right of way thereto, timing mechanism associated with said means including means for operating said devices to accord right of way to said street for a predetermined initial period and means responsive to following traffic on said street for extending the period of operation of the devices to maintain the right of way on said street for additional periods, means responsive to traffic on another of the respective streets for controlling the operation of said devices to appropriate right of way from the first street after operation of said mechanism, and means including a synchronous motor and contact mechanism operated thereby for governing the beginning and termination of said intervals.

4. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, mechanism for operating said devices, means responsive to traffic and cooperating with said selective mechanism for initiating operation of said mechanism to accord the right of way on one of the respective streets for a predetermined initial period, means for extending the period of operation of said signal devices to maintain the right of way on said one street for additional periods, said period extending means being responsive to following traffic on said one street only during successive limited time intervals occurring after the first response of said traffic responsive means to traffic, means responsive to traffic on another of the respective streets for controlling the operation of said devices to appropriate the right of way from the first street after operation of the first traffic responsive means and the period extending means, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods, and timing mechanism for rendering said last means inoperative at predetermined time intervals.

5. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, traffic responsive mechanism on each street, means actuable by said traffic responsive mechanism for operating the devices to accord right of way to each street for a predetermined initial period, means associated with said traffic responsive mechanism and responsive to actuation thereof only during a predetermined period near the end of said initial period for controlling said devices to continue the right of way on said street for an additional period, mechanism operable by said traffic responsive mechanism for transferring right of way from one to another of the respective streets after operation of said means, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods, and timing means for rendering said last means inoperative at predetermined time intervals.

6. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets and including a "stop" signal for each street, vehicular traffic responsive means controlling the energization of the devices to accord the right of way to vehicular traffic on one of the streets, means for maintaining the right of way on said street for a predetermined initial period and for further extension periods determined by the density of traffic on said street, means operable by a pedestrian seeking to traverse at least one of the streets of the intersection for appropriating control of said signal devices upon completion of the operation of said last means and energizing the "stop" signal devices for all streets, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

7. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets and including a "stop" signal for each street, vehicular traffic responsive

means connected to said devices for controlling the energization thereof to grant right of way to vehicular traffic on one of said streets in response to the approach of vehicles on said street, means actuable by vehicular traffic in another of said streets for controlling the operation of said devices to appropriate the right of way from the first street in response to the traffic on said second street, means operable by a pedestrian desiring to traverse at least one of the streets of the intersection for controlling the operation of said devices to appropriate the right of way from the first street and energize the "stop" signals for all streets, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

8. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, mechanism for operating said devices, traffic responsive means for each street connected to said mechanism for initiating operation of said devices to accord the right of way on the respective street, mechanism associated with said means on each street operable to control said devices to maintain the traffic right of way on the street for a predetermined initial period and for additional periods determined by traffic on said street, and continuously operating synchronous means locally energized by alternating current operable at predetermined time intervals for alternately terminating operation of said last mechanisms for the respective streets.

9. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for granting right of way to one of said streets, mechanism for operating said devices, traffic responsive means connected to said mechanism for initiating operation of said devices to accord the right of way to one of the respective streets, mechanism associated with said means operable to control said devices to maintain the traffic right of way on said one street for a predetermined initial period and for additional periods in response to traffic on said street, and means responsive to traffic on another of the respective streets adapted to render said second mechanism inoperative at a predetermined time and appropriate control of said devices to accord the traffic right of way to said second street, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

10. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices, for selectively according right of way to said streets, mechanism for operating said devices, means responsive to traffic and cooperating with said selective mechanism for initiating operation of said mechanism to accord the right of way to one of the respective streets, mechanism associated with said means operable to control said devices to maintain the traffic right of way on said one street for a predetermined initial period and to extend the duration of the right of way on said street for a further maximum period in response to further operation of said traffic responsive means on said one street near the end of the first predetermined period of time, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

11. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, mechanism for operating them, means responsive to traffic connected to said mechanism for initiating operating of said devices to signal the right of way on at least one street to said traffic, means for rendering said first means unresponsive to following traffic on said one street for a predetermined period of time after the first response of said means to said traffic and for maintaining the said right of way on said one street for a longer predetermined period of time, means for extending the duration of the right of way on said street for a second predetermined period of time in response to approach of traffic on said one street near the end of the first predetermined period of time, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and mechanism operable at predetermined time intervals for terminating the operation of said last means.

12. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets and including a "stop" signal for each street, means controlling the operation of the devices in the alternative to provide the right of way to vehicular traffic on the streets, means responsive to pedestrian traffic seeking to negotiate at least one of the streets of the intersection for appropriating the control of said means to operate the "stop" signal devices for all streets for a predetermined initial time interval, means reasponsive to pedestrian traffic following said first pedestrian traffic for operating the "stop" signal devices for all streets for an additional period of time, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and mechanism operable at predetermined time intervals for terminating the operation of the last means.

13. In a traffic regulating unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets and including a "stop" signal for each street, means controlling the operation of the devices in the alternative to provide the right of way to vehicular traffic on the streets, means responsive to pedestrian traffic seeking to negotiate at least one of the streets of the intersection for appropriating the control of said means to operate the "stop" signal devices for all streets for a predetermined initial time interval, mechanism responsive to actuation of said pedestrian traffic responsive means by following pedestrian traffic for extending the period of operation of said "stop" signals an additional predetermined time interval, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and mechanism operable at predetermined time intervals to terminate operation of said last mechanism and accord the traffic right of way to said street.

14. In a traffic control unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to

said streets, means responsive to traffic on one of the streets for controlling the devices to accord right of way to said street, timing mechanism associated with said means for maintaining right of way on said street for a predetermined initial period, timing means responsive to traffic on said street for maintaining right of way to said street for at least one additional period, mechanism associated with said last means for terminating operation thereof at a predetermined time after the beginning of the initial period, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods.

15. In a traffic control unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, means responsive to traffic on one of the streets for controlling the devices to accord right of way to said street, timing mechanism associated with said means for maintaining right of way on said street for a predetermined initial period, means for maintaining right of way on said street for additional periods, said last means being responsive to traffic on said street only near the end of the preceding period during which right of way is accorded to said street, mechanism for terminating operation of said last means at a predetermined time after beginning of the initial period, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and mechanism operable at predetermined time intervals to terminate operation of said last means independently of said last mechanism.

16. In a traffic control unit for an intersection of at least two streets, the combination of signal devices for selectively according right of way to said streets, means responsive to traffic on one of the streets for controlling the devices to accord right of way to said street, timing mechanism associated with said means for maintaining right of way on said street for a predetermined initial period, timing means responsive to traffic on said street for maintaining right of way to said street for at least one additional period, mechanism operable at predetermined time intervals to terminate operation of said last means, means responsive to traffic on another of said streets for appropriating control of said devices upon completion of the operation of said timing mechanism and timing means, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and means for rendering said last means inoperative at predetermined time intervals.

17. In a traffic control unit for an intersection of two streets, the combination of signal devices for selectively according right of way to said street, timing mechanism for each street including means for operating said devices to accord right of way to the street for a predetermined initial period and means for operating said devices to maintain right of way on the street for additional periods, said last means being operable to accord an additional right of way period only when traffic appears on the street near the end of the preceding period of right of way on the street, means responsive to traffic on each of the streets for appropriating control of the devices to accord right of way to one of the streets after operation of the timing mechanism for the other street, means operable at predetermined time intervals to terminate operation of the timing mechanisms for the respective streets, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and means for rendering said traffic responsive means inoperative at predetermined time intervals.

18. In a traffic control unit for an intersection of two streets, the combination of signal devices for selectively according right of way to said street, timing mechanism for each street including means for operating said devices to accord right of way to the street for a predetermined initial period and means for operating said devices to maintain right of way on the street for additional periods, said last means being operable to accord an additional right of way period only when actuated near the end of the preceding period of right of way on the street, mechanism associated with said last means for terminating operation thereof at a predetermined time after the beginning of the initial periods for the respective streets, means responsive to traffic on each of the streets for appropriating control of the devices to accord right of way to one of the streets after operation of the timing mechanism for the other street, means operable at predetermined time intervals to terminate operation of the timing mechanisms for the respective streets, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and means for rendering said traffic responsive means inoperative at predetermined time intervals.

19. In a traffic control unit for the intersection of two streets, the combination of traffic signalling devices for selectively according right of way to said street, means normally controlling said devices to maintain right of way to traffic on one of the streets, means responsive to traffic on the other street for appropriating control of said devices to accord right of way to said second street, timing mechanism for the second street including means for controlling said devices to accord right of way thereto for a predetermined initial period and means responsive to traffic on the second street for maintaining right of way thereon for at least one additional period, means for appropriating control of the devices to return the right of way to the first street after the operation of said timing mechanism, means operable at predetermined time intervals for terminating operation of the timing mechanism, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and means for rendering said control appropriating means inoperative at predetermined time intervals.

20. A traffic control system for a main street having a plurality of cross street intersections therealong, which comprises signalling devices for each intersection for selectively according right of way to the streets of said intersection, timing mechanism for each intersection including means for controlling operation of the devices at the corresponding intersection to accord right of way to the main street for a predetermined initial

period and means for maintaining the right of way on the main street at the corresponding intersection for at least one additional period, said last means being responsive to traffic on the main street near the corresponding intersection, mechanism individual to each intersection and responsive to cross street traffic thereat for appropriating control of the corresponding devices to accord right of way to the cross street after operation of the timing mechanism for the corresponding intersection, and means including a continuously operating synchronous motor and contact mechanism driven thereby and governing the beginning and termination of said right of way periods and means for rendering the last mechanism at each intersection inoperative at predetermined time intervals.

21. In a system for regulating the flow of traffic at a plurality of intersections along a thoroughfare, traffic regulating means including signaling devices at each intersection, a common source of alternating current supplying all of said traffic regulating means, timing mechanism including a synchronous motor in each traffic regulating means and contact mechanism driven thereby, means delaying operation of said traffic regulating means until said contact mechanism is in a predetermined condition, and means operable by a vehicle and including switching means cooperating with said contact mechanism and arranged to initiate operation of said traffic regulating means.

22. A traffic control system for a main street having a plurality of cross street intersections therealong, which comprises signalling devices for each intersection for granting right of way to the streets of each intersection according to a predetermined time schedule, timing mechanism for each intersection including means for controlling operation of said signaling devices at the corresponding intersection, and means for according right of way to the main street for a predetermined initial period and means for maintaining the right of way on the main street at the corresponding intersection for at least one consecutive additional period, said last named means being responsive to traffic on the main street near the corresponding intersection, mechanism individual to each intersection and responsive to cross street traffic thereat for appropriating right of way from said main street and accord right of way to the corresponding cross street after operation of the timing mechanism for the corresponding intersection, and means including a synchronous motor energized from an alternating current source common to all intersections and including contact mechanism operated by said motor, and means controlled by said contact mechanism for governing the beginning and termination of said right of way intervals at the corresponding intersection.

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