Aug. 24, 1937. J. L. BIACH ET AL 2,090,619

TRAFFIC CONTROL SYSTEM

Filed April 23, 1930 4 Sheets-Sheet 1

Fig. 1.

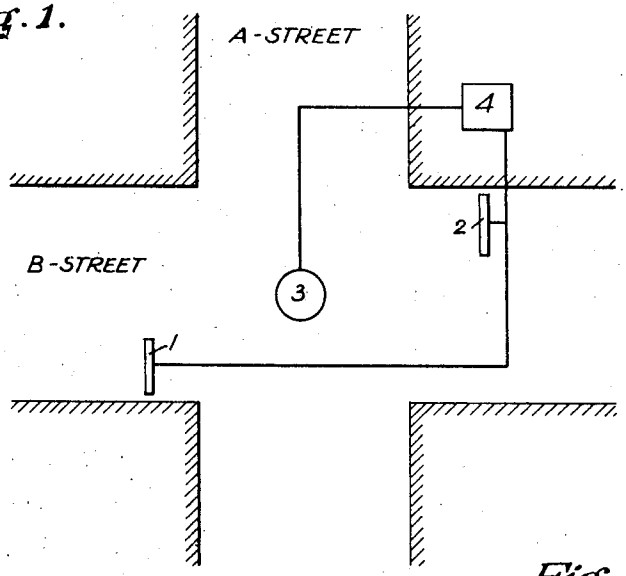


Fig. 2.

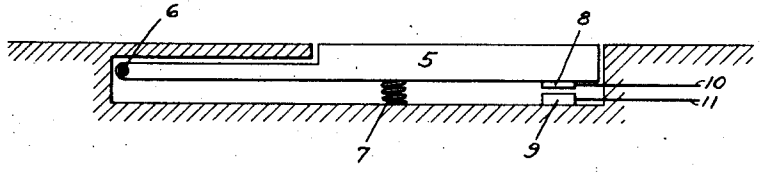
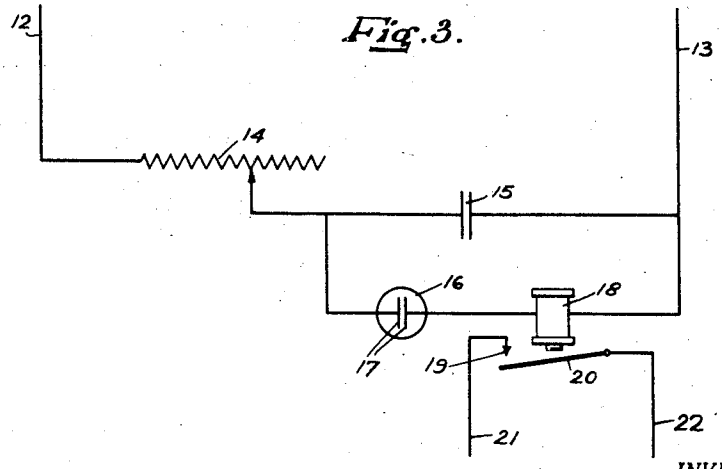


Fig. 3.



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Fig. 4.

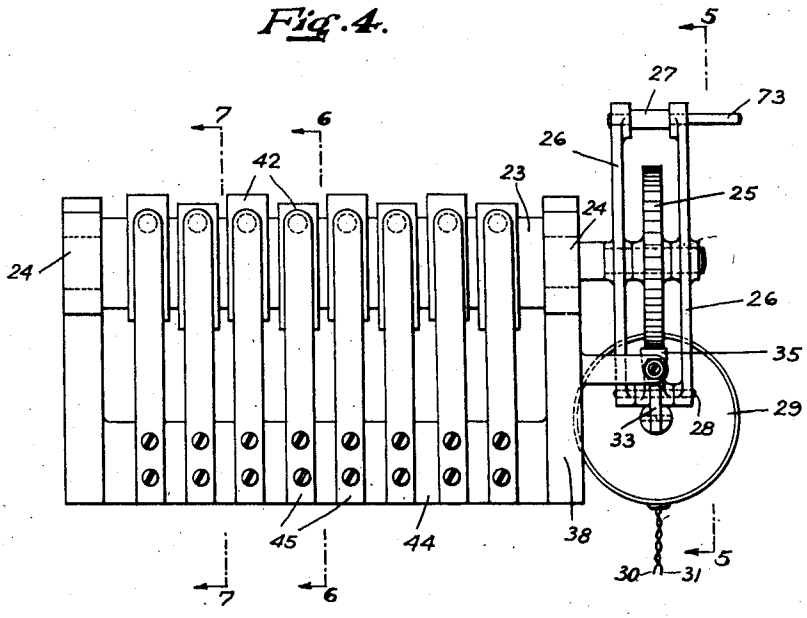
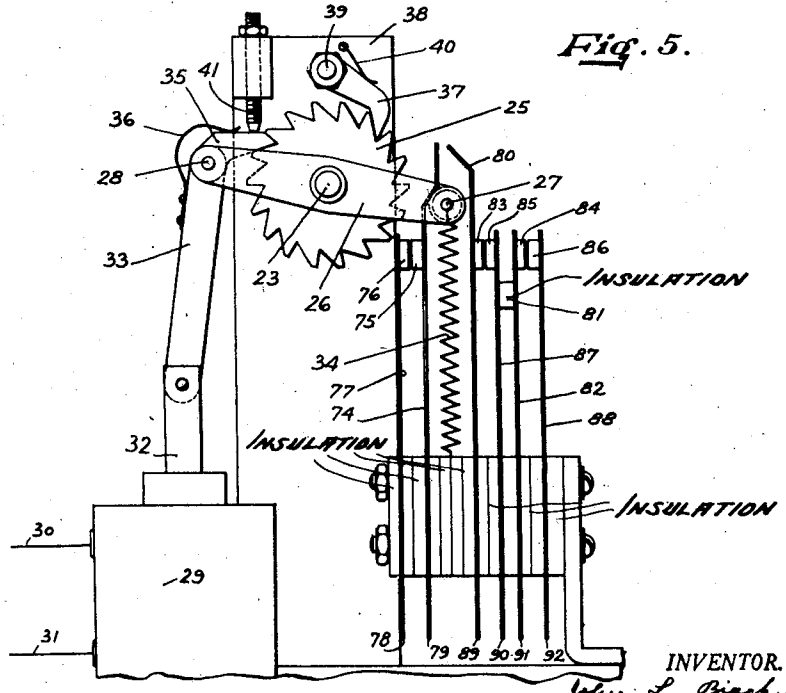


Fig. 5.



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Fig. 6.

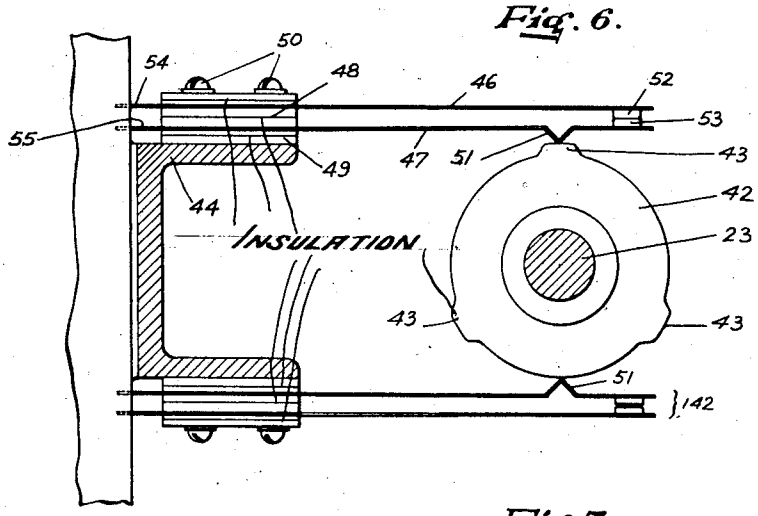
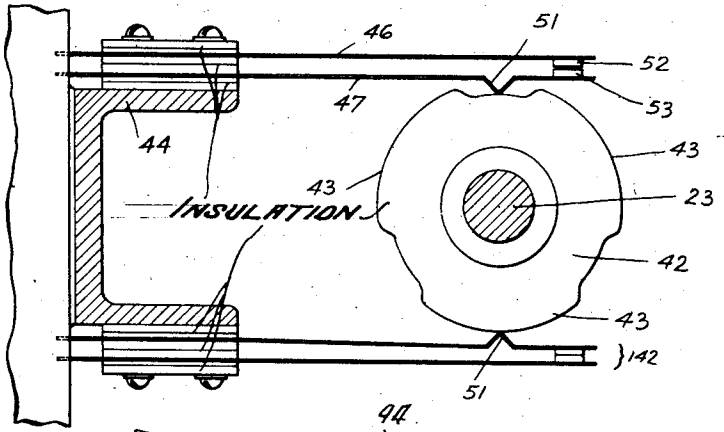


Fig. 7.



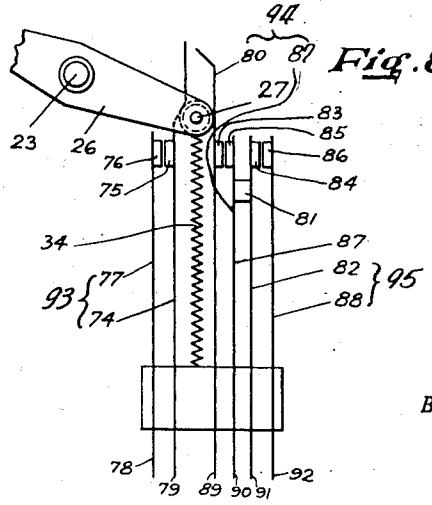


Fig. 8.

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TRAFFIC CONTROL SYSTEM

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Fig. 9.

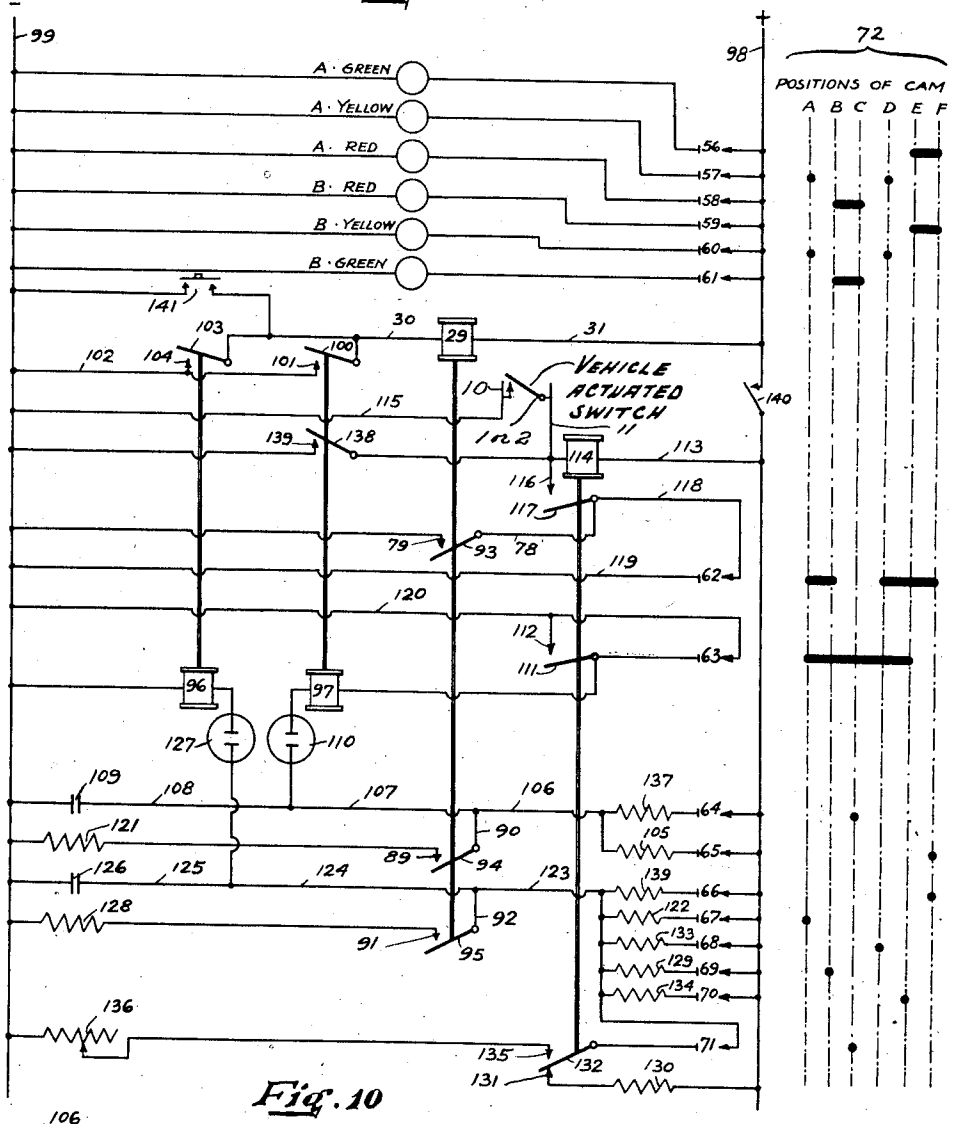
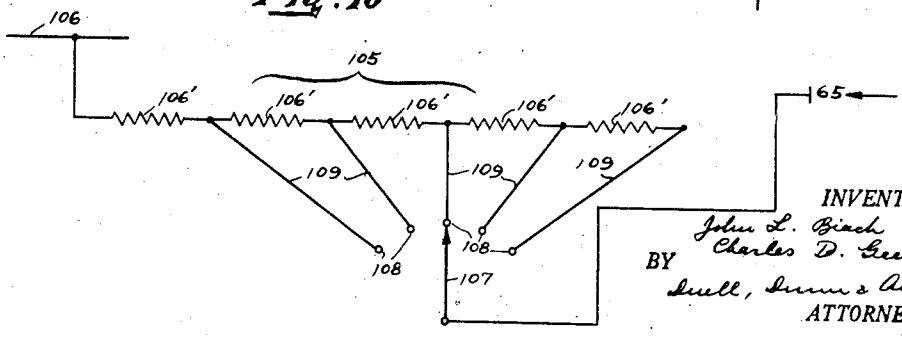


Fig. 10



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Patented Aug. 24, 1937 2,090,619

UNITED STATES PATENT OFFICE

2,090,619

TRAFFIC CONTROL SYSTEM

John L. Biach and Charles D. Geer, New Haven, Conn., assignors to The Engineering and Research Corporation, New Haven, Conn., a corporation of Connecticut

Application April 23, 1930, Serial No. 446,454

25 Claims. (Cl. 177—337)

This invention relates to a functionally and structurally improved traffic control system and aims to provide an apparatus of this character capable of use in numerous different associations but primarily intended to be employed at the point of intersection of two or more vehicle lanes such as roadways.

Certain features disclosed in the present case are also disclosed in Patent 2,044,907, issued June 23, 1936, to Frederick G. Kelly, and certain other features are also disclosed in co-pending applications Serial Numbers 73,156 and 446,480, which patent and co-pending applications have a common assignee with the present case, and the claims in the present case are restricted to features not disclosed in the aforesaid patent and co-pending applications.

The features of resetting the condenser charge of the timing condenser by vehicle actuation to extend a right of way signal period in inverse proportion to the speed of the actuating vehicle, and of controlling the charge and discharge of the timing condenser by vehicle actuation are disclosed and claimed in the aforesaid Patent 2,044,907 to Frederick G. Kelly and claims to these features as such are made in the aforesaid patent and these features as such are not claimed in the present case.

The periodic call feature in which right of way is transferred automatically from one street to the other and back at relatively long intervals on each street in the absence of traffic, subject to earlier transfer of right of way between shorter minimum and maximum intervals by vehicle actuation, is disclosed and claimed in the aforesaid co-pending application Serial Number 73,156, filed April 7, 1936, by Charles D. Geer, which is a division of the aforesaid co-pending application Serial Number 446,480 as originally filed April 23, 1930, and claims to this feature as such are not made in the present case.

The feature of an initial right of way interval on the side street, preceding a side street right of way period which is extendable by traffic actuation, to provide that traffic waiting on the side street at the start of the right of way period thereon may get into motion by the time the extendable right of way period begins is disclosed and claimed in the aforesaid co-pending application Serial Number 446,480 of John L. Biach and Harry A. Wilcox, filed April 23, 1930, and no claims to this feature broadly as such are made in the present case.

It is an object of the invention to provide a layout of apparatus furnishing a system operating automatically to expeditiously handle traffic and by means of which danger of accidents will be reduced to a minimum aside from the fact that the functionings of the system will at all times be dependent upon actual traffic conditions. Moreover, by means of the present invention, a minimum of apparatus is required and this apparatus will be extremely rugged and relatively simple in construction and when once installed will operate with minimum manual attention and with freedom from mechanical or electrical difficulties over long periods of time.

A further object is that of providing an apparatus of this character, the several parts of which may be manually adjusted to function according to the peculiarities of traffic conditions as actually existing at the point of installation of the system. Accordingly, the same manufacturing specifications may be followed for any desired number of systems and these individual systems may be readily adjusted after installation to meet the conditions then existing aside from the fact that if these conditions change through the course of time, further and simple adjustments may be made to allow for such changes.

A further object of the invention is that of providing an apparatus furnishing a traffic control system capable of installation to advantage in any number of instances but of particular value at an intersection where vehicle lanes of unequal dignity meet. In other words, this system will be of great utility when installed at a highway intersected by cross streets wherein under ordinary circumstances, the traffic flow along the highway exceeds materially the traffic flow across the same.

Another object is that of providing apparatus primarily intended to be employed in connection with traffic control systems and particularly systems which govern the flow of traffic over roads frequented by automobiles, but which apparatus while primarily intended for this purpose is capable of employment to advantage in other associations wherever it may prove to be of value.

With these and further objects in mind, reference is had to the attached sheet of drawings illustrating one practical embodiment of the invention, and in which:

Fig. 1 illustrates diagrammatically a street intersection with the system associated therewith;

Fig. 2 schematically indicates a vehicle actuated control forming a part of this system;

Fig. 3 shows one unit of the timer apparatus;

Fig. 4 is a plan view of the timer or control apparatus of the system;

Figs. 5, 6 and 7 are sectional views taken along the lines 5—5, 6—6, and 7—7 and in the direction of the arrows as shown in Fig. 4;

Fig. 8 is a somewhat diagrammatic view of details of certain of the apparatus as shown in Fig. 5;

Fig. 9 is a somewhat diagrammatic view of the layout of apparatus involved in the control and timer unit; and

Fig. 10 represents diagrammatically one of the manual controls for adjusting the factors controlled by the timer.

A self regulating automatical traffic control system embodying our invention may comprise 3 parts; a vehicle actuated control or indicator placed in or at the side of the road; an electrical time limiting control system; and a signal device to indicate right of way to traffic. A function of the indicating device is such that vehicles approaching on the cross street actuate electrical control circuits. These actuations control the operation of the electrical time limiting control system, which in turn controls the right of way device. The right of way device for informing the traffic in each street when to go and when to stop may be the standard red, yellow and green lights now in general use, but may also be any other convenient or desirable type. The vehicle actuated means may be of several types as hereinafter mentioned: One means of control actuated by the approaching vehicle may be of a mechanical nature such as a mechanical switch located in or at the side of the street, an electrical contact being made upon passage of the vehicle.

Another control for detecting and recording the presence of an approaching vehicle may be a beam of light projecting across the highway and received upon a photo-electric or light sensitive cell, so that an approaching vehicle causes a fluctuation in an electrical current passing through the photo-electric or light sensitive cell.

An electrical magnetic device located in or at the side of the street may also be arranged in such manner that an approaching vehicle shall actuate the device to control an electrical circuit. Obviously, any other form of vehicle indicator could be used.

The time limit control device operates as follows: Assume there are no vehicles approaching on the cross street designated by B. Then the right of way will be indicated to the highway designated by A. A vehicle approaching on B street now operates the actuating means and the control mechanism, after showing a suitable warning signal, transfers right of way to B street. B street now has the right of way and vehicles approaching on it may cross the intersection. The right of way will be transferred back to A street under either of the following conditions:

Case I—As soon as all traffic has ceased on B street.

Case II—If traffic continues to approach on B street at the end of a predetermined period, the right of way is transferred back to A street. The various periods are controlled by suitable timing mechanisms.

Provision to transfer the right of way to A street as outlined under Case I, is accomplished through the use of timing mechanisms which provide sufficient time for the individual B street vehicles to cross the intersection. This timing mechanism is reset toward its starting position each time a vehicle operates the B street actuating means. Hence, if no further vehicles approach on B street, this timing mechanism will eventually finish timing the period it is set for, and when such time is reached, the right of way is transferred to A street.

To provide for Case II, in which continuous B street traffic must be interrupted, other timing mechanism is provided which is not reset by vehicles on B street; and when it has timed the period it is set for, right of way is transferred to A street.

When right of way is transferred as in Case II, vehicles are on B street which have not had sufficient time to cross the intersection, even though they have actuated the B street actuating means. The control system is left in such a condition that right of way will eventually be transferred to B street without requiring any additional actuating of the B street vehicle actuated means.

The timing mechanism which is reset by traffic, is so arranged that it may be reset in accord with the speed of the vehicle causing the resetting. Thus the time or protection period given each vehicle is commensurate with the speed of the vehicle. In this manner, no vehicle receives an unnecessarily long protection period, avoiding needless delay in the highway.

Whenever right of way is given to the highway, it must remain showing on the highway for at least a certain minimum period before it may again be transferred to the cross street. This is accomplished by providing a timing mechanism which starts timing as soon as right of way is given to the highway and prevents transfer to the cross street until it has timed the period it is set for.

If several vehicles have passed the actuating means while being given the stop signal, some time will elapse, after they have been given the right of way signal, before the last of said vehicles gets into motion. For this reason, an additional timing mechanism is provided which introduces an additional initial protection period at the expiration of which the resettable protection period begins. This time is sufficient to allow the waiting vehicles to get into motion.

In order to provide for the occasional shifting of right of way to the cross street, even though there are no waiting vehicles thereon, is accomplished by providing a timing mechanism which begins to time as soon as right of way is given to the highway, and unless right of way is transferred to the cross street previously, due to vehicles approaching on the cross street, transfers right of way when it has finished its timing period. While we have described above a self regulating automatical traffic control system embodying our invention, and have shown that this invention may comprise three interconnected parts, we now describe in detail the construction of one complete and specific system embodying our invention.

Referring to Fig. 1 of the drawings, there is shown a complete self regulating traffic control system applied to intersecting streets A and B. A represents the highway, and B the cross street. Vehicle actuated control means are located in the cross street only, and are indicated by numerals 1 and 2. The signal means in this particular embodiment is indicated by 3 and contains red and green electrical lamps, reflectors and/or lenses visible from either direction on A street, but not visible on B street; red and green electric lamps, reflectors and/or lenses visible from either direction on B street, but not visible on A street; a yellow electric lamp, reflector and/or lens visible from either direction on A

street, and a yellow electric lamp, reflector and/or lens visible from either direction on B street. The electrical time limiting control is indicated by 4. The lines connecting vehicle actuated means 1 and 2, the time limiting control 4, and the signal 3 indicate controlling circuits. Thus the vehicle actuated devices control the time limiting control 4, and the time limiting control 4 controls the signal 3.

Fig. 2 shows schematically one form of vehicle actuated control consisting of a ramp 5 hinged at 6 and forced into the elevated position by spring 7. The top surface of the ramp may be substantially on the level of the street. When the wheel of a vehicle passes over the unit, the weight of the vehicle depresses ramp 5 causing contacts 8 and 9 to be pressed together, closing a circuit between wires 10 and 11. When the wheel leaves ramp 5, spring 7 forces the ramp into an elevated position separating contacts 8 and 9 and breaking circuit between wires 10 and 11. The vehicle actuated devices 1 and 2 are connected in parallel.

The time limiting control uses several timing mechanisms. One embodiment of such a timing mechanism is shown schematically in Fig. 3. When a source of voltage supply is connected between wires 12 and 13, current flows through adjustable resistance 14 and condenser 15. Thus the voltage of the supply is applied to condenser 15 through resistance 14, and the voltage of the condenser begins to build up at a definite rate determined by the size of the condenser, the resistance 14 and the voltage of the supply. Shunting condenser 15 is a circuit including a glow tube 16 and a relay 18. The glow tube comprises a bulb containing a suitable gas into which electrodes 17 extend. This tube has such a characteristic that it is normally non-conducting, but when the voltage across its terminals reaches a certain critical or threshold value, the gas ionizes and becomes a good electrical conductor and will not become non-conducting again until the voltage across its terminals has dropped considerably below the critical ionizing voltage. The voltage of the supply is greater than the critical voltage of tube 16. When the voltage across the condenser is built up to the critical voltage of the tube, the tube suddenly becomes conducting, causing current to flow momentarily from condenser 15 through tube 16 and relay 18, causing relay 18 to operate momentarily. This effects a momentary contact between armature 20 and contact 19 and thus momentarily closes circuit between wires 21 and 22.

The interval elapsing between the application of the supply voltage to wires 12 and 13, and the operating of relay 18, is the period timed by the mechanism. By suitable adjustment of resistance 14, any desired interval may be obtained. The above description shows only the fundamentals of the timing mechanism and the details may be varied considerably as will be explained later. In addition, while relay 18 has been shown as closing one circuit, it may obviously close several circuits, or open circuits. One example of this general type of timing mechanism is shown in Patent No. 1,909,471 issued May 16, 1933, to Frederick G. Kelly, Jr.

Before describing the details of the time control mechanism, one portion of it, as shown in Figs. 4, 5 and 6, will be reviewed. Referring to Fig. 4, there is shown a shaft 23 rotatively mounted in bearings 24. Keyed to shaft 23 is the toothed wheel 25. Referring to Fig. 5, there is shown the toothed wheel mounted on the shaft 23. Also mounted on the shaft 23, and freely movable with respect thereto, are members 26, one on each side of wheel 25. The ends of the two members 26 are connected together as at 27 and 28. Magnet 29, the terminals of its winding being indicated by wires 30 and 31, attracts core 32 when energized. By means of link 33, core 32 is connected to members 26. It will thus be appreciated that, whenever magnet 29 is energized, the two members 26 are rotated in a counter-clockwise direction. Spring 34 is attached to rivet 27, and consequently, whenever magnet 29 is deenergized, the two members 26 are rotated in a clockwise direction. The connecting pin 28 also carries live pawl 35, which is forced against toothed wheel 25 by spring 36. Dead pawl 37, mounted on the frame 38 at 39, also is forced against the toothed wheel 25 by a spring 40. The pawl 37 prevents any counter-clockwise motion of toothed wheel 25, and therefore, whenever magnet 29 is energized, the rotation of members 26 causes live pawl 35 to slip past wheel 25. Motion of members 26 would be adjusted so that pawl 35 moves past and engages with the next tooth of wheel 25. When magnet 29 becomes de-energized, spring 34 rotates members 26 in a clockwise direction, and pawl 35, being in engagement with wheel 25, rotates wheel 25 in a clockwise direction. An adjustable set screw 41 limits the clockwise motion of members 26 to the amount of one tooth of wheel 25. As wheel 25 moves in a clockwise direction, pawl 37 slips past the next tooth of wheel 25 and at the end of the motion, engages this next tooth. The mechanism is returned to the position shown in Fig. 5, except that wheel 25 has been rotated through the angle subtended by one tooth. It will thus be appreciated that the successive energizing and de-energizing of magnet 29 causes a notching motion of wheel 25. Since shaft 23 is keyed to wheel 25, shaft 23 rotates in synchronism with wheel 25. In this particular embodiment, there is shown a wheel 25 having 18 teeth.

Mounted upon shaft 23 are a series of spaced cams 42 keyed to shaft 23. Fig. 6 shows in detail a side elevation of one of the cams. It will be noticed that the cam is circular in shape, and carries 3 equally spaced projections 43. Mounted upon frame 38 is a member 44 carrying circuit makers 45. The details of these circuit makers are shown in Fig. 6. It will be noticed that they may consist of two flat strips 46 and 47. The two strips are separated by an insulator 48, and they are separated from member 44 by an insulator 49. They are supported on member 44 by means of screws 50. Member 47 has a V shaped projection 51, and each member 46 and 47 carries contact 52 and 53. Both member 46 and member 47 are preferably of springy material, and member 47 is tensed so that the edge of the V shaped projection 51 always rests against cam 42. When resting against the circular part of cam 42, member 47 is in a down position causing contacts 52 and 53 to separate. But when, during the cycle of revolution of cam 42, projection 43 moves under the projection 51, member 47 is raised bringing contacts 52 and 53 into contact. In this manner circuit between leads 54 and 55 is made during the time projection 51 rests upon projection 43. It will furthermore be noticed that circuit between wires 54 and 55 is made 3 times per revolution of cam 42. As described above, motion of cam 42 is not continuous but proceeds in a series of steps, 18 per revolution. The pro-

jection 43 can be so constructed that during one position of cam 42, contact between 52 and 53 is made, and during the next succeeding 5 positions, contact between 52 and 53 is broken. Similarly, by making projection 43 subtend twice the portion of the surface of cam 42, as shown in Fig. 7, contact between 52 and 53 may be made during four positions and broken during the next succeeding two positions. Obviously, a similar change in construction would allow contact between 52 and 53 to be made in any desired positions.

Fig. 8 shows in still greater detail, one end of member 26 and connecting pin 27. It will be noticed, as in Fig. 4, that pin 27 extends beyond member 26 in the form of projection 73. When magnet 29 is de-energized and spring 34 has moved member 26 as far as it will go in a clockwise direction, projection 73 disengages spring 74, moving its contact 75 out of engagement with the contact 76 carried by spring 77, and circuit between wires 78 and 79 is broken. When magnet 29 is energized, projection 73 presses against spring 74 as soon as member 26 begins to move, and circuit between wires 78 and 79 is again established. As soon as member 26 is moved in a counter-clockwise direction as far as it will go, this being adjustable by limiting the travel of core 32, projection 73 engages spring 80 and through insulating post 81 engages spring 82. Contacts 83 and 84 carried by springs 80 and 82 respectively, move into contact with contacts 85 and 86 carried by springs 87 and 88 respectively, completing circuit between wires 89 and 90 and between wires 91 and 92. When magnet 29 becomes de-energized, spring 34 immediately begins to return members 26 to their former position. As soon as the clockwise motion of member 26 begins, circuit between wires 91 and 92 is broken and circuit between wires 89 and 90 is also broken. Just as member 26 reaches its completely de-energized position, projection 73 moves out of engagement with spring 74, and circuit between wires 78 and 79 is broken. While in the illustrated embodiment the contacts separate incident to spring action, it will be understood that this action might be supplemented by positive engagement with the pin 73 or its equivalent so that as the latter moves to one position, a positive removal of one contact from engagement with the other is assured.

Fig. 9 shows the complete wiring diagram of the control mechanism, and 72 represents the cams in developed form; one-third of one revolution being shown, the other two-thirds being mere duplications. It will be noticed that there are 16 cams and numerals 56 through 71 represent contacts operated by these cams. The scheme of representation shown under numeral 72 is as follows: In one position, for example, A, contacts 57, 60, 62, 63 and 67 are closed. If magnet 29 is now energized and de-energized, the cams will be notched or shifted to position B. Contacts 62 and 63 remain closed. Contacts 57, 60, and 67 are now open, but contacts 58, 61, and 69 are closed. The operation is similar as the cams are notched successively to positions C, D, E and F. In this figure the notching magnet 29 is again indicated and whenever energized, operates the 3 switch members 93, 94, and 95 which represent schematically the 3 circuit closers shown in Fig. 8. Armature 93 is the one which is closed as soon as the motion of member 26 starts and 94 and 95 are the two which are closed at the end of the motion of member 26. The circuits closed are designated by the same numerals as in Fig. 8. Elements 96 and 97 represent relays, and whenever either relay is energized, magnet 29 is energized because current flows from wire 98 through wire 31, magnet 29, wire 30, and, in case relay 97 was energized, through armature 100, contact 101, wire 102 and wire 99 and, in case relay 96 was energized, through armature 103, contact 104, wire 102 and wire 99. Wires 98 and 99 are connected to a source of power.

Switch 140 is provided to permit power to the timing to be interrupted while the signals remain illuminated in any desired position of the cam shaft. This switch may be operated manually or by remote control means and may be used in cooperation with switch 141 to provide complete manual control of solenoid 29 and thus of the signals. Either of these switches can be operated by a traffic authority or otherwise, at will.

As will appear later, when all traffic has ceased on street B, the apparatus will eventually come to rest in position F. In this position contact 56 is closed lighting the A street green signal, and contact 59 is closed, lighting the B street red signal. Thus, the right of way is being given to the highway and vehicles may proceed on that street. At the same time, contact 65 is closed allowing current to flow from wire 98 through contact 65, resistance 105, wire 106, wire 107, wire 108, condenser 109 and wire 99, and the voltage of condenser 109 begins to build up at a rate determined by the value of resistance 105. Assume that this resistance is adjusted so that condenser 109 is charged up to the critical voltage of tube 110 in thirty seconds. However, even though condenser 109 reaches the initial voltage of tube 110, tube 110 does not become conducting because its discharge circuit is open at contact 63 and in addition is open at armature 111 and contact 112. Thus, the system remains inactive and right of way continues to be shown to the highway.

If a vehicle approaches on the cross street operating one of the vehicle actuated control devices located there, circuit between wires 10 and 11 will be closed momentarily allowing current to flow from wire 98 through wire 113, relay 114, circuit 11 and 10, wire 115 and wire 99. This would effect only a momentary closure of relay 114 were it not for the locking circuit consisting of contact 116, armature 117, wire 118, contact 62, (contact 62 being made in position F), and wire 119, this locking circuit being made when relay 114 operates. When relay 114 operates, it closes contact between armature 111 and contact 112, completing the circuit shunting condenser 109 through wire 120. Tube 110 becomes conducting and the energy stored in condenser 109 discharges through relay 97 operating it momentarily. This closes contact between armature 100 and contact 101, energizing magnet 29 which in turn rocks the notching mechanism consisting of members 26. As soon as core 32 has been fully attracted, circuit between wires 89 and 90 is made which shunts resistance 121 directly across the terminals of condenser 109. Resistance 121 is of a very low value, its only purpose being to prevent arcing when switching mechanism 94 closes. This allows any energy remaining in condenser 109 to be dissipated in resistance 121, tube 110 becomes non-conducting, the energizing circuit of magnet 97 is consequently broken, armature 100 separates from contact 101 and magnet 29 becomes de-energized. This allows members 26 to return to their de-energized position, and in so doing, they shift or notch the cams from position F to position A.

In position A, contact 57 is closed, lighting the

A street yellow signal, and contact 60 is closed, lighting the B street yellow signal. At the same time contact 63 is closed insuring that the discharge circuit of condenser 109 shall remain closed regardless of subsequent action to relay 114. At the same time contact 67 is closed allowing current to flow from wire 98 through contact 67, resistance 122, wire 123, wire 124, wire 125, condenser 126 and wire 99, and in a similar manner the voltage of condenser 126 begins to build up at a rate determined by the value of resistance 122. Assume that the period required is 2 seconds. At the end of two seconds, condenser 126 reaches the critical voltage of tube 127 and the energy stored in condenser 126 discharges through tube 127 and relay 96. Relay 96 operates, closing circuit between armature 103 and contact 104, energizing magnet 29, which in turn rocks the notching mechanism consisting of members 26. When members 26 have moved to their extreme energized position, switching device 95 closes circuit between wires 91 and 92, placing resistance 128 directly across the terminals of condenser 126. Resistance 128 is similar to resistance 121 and performs the same function for condenser 126 that resistance 121 performs for condenser 109. The remaining energy of condenser 126 being dissipated in resistance 128, relay 96 becomes deenergized, deenergizing magnet 29 which allows members 26 to again move forward the cams, which shift from position A to position B.

In position B, contact 58 is closed lighting the A street red signal, and contact 61 is closed lighting the B street green signal. The right of way is now being given to B street and the vehicle which approached there may cross. In position B, contact 69 is closed and current flows into condenser 126 through resistance 129, and condenser 126 reaches the critical voltage of tube 127 in 3 seconds. At this moment, tube 127 again becomes conducting and the notching operation proceeds in the very same manner previously described advancing the cams from position B to position C. In moving from position B to position C, there is no change in the signal lights. Contacts 58 and 61 remaining closed. Contact 62, however, is opened, which breaks the locking circuit of relay 114 which drops to its deenergized position. In addition, contact 71 is closed, and since relay 114 is deenergized, current flows from wire 98 through resistance 130, contact 131, armature 132, contact 71, wires 123, 124 and 125, condenser 126 and wire 99, and similarly the voltage of condenser 126 begins to build up at a rate determined by resistance 130. Assume that this resistance is set so that condenser 126 builds up to the critical voltage of tube 127 in 7 seconds. Assuming that no further cars approach on the cross street, then after 7 seconds, condenser 126 will discharge through tube 127, performing the very same steps of the notching operation described previously. This notches the cams from position C to position D.

In position D, contacts 57 and 60 are again made, lighting both the A and B street yellow lights. In addition, contact 68 is made which closes the charging circuit of condenser 126 through resistance 133. Assuming that resistance 133 is set to charge condenser 126 up to the critical voltage of tube 127 in 2 seconds, then condenser 126 will discharge after 2 seconds, and the notching operation will proceed again as described previously, shifting the cams from position D to position E.

In this position, contacts 56 and 59 are made, lighting the A street green signal and B street red signal, and the right of way has returned to the highway. At the same time contact 70 is made which charges condenser 126 through resistance 134 as previously described. Assume that the period timed, as determined by the setting of resistance 134, is 5 seconds. Then after 5 seconds, the advancing operation will again proceed, as previously described, and the cams will be moved from position E to position F. We have reached the condition described at the beginning and charging of condenser 109 starts, contact 65 being made. But after condenser 109 has reached the critical voltage of tube 110, it does not discharge through said tube because the discharge circuit is open, as described previously.

We have thus described the operation of the device assuming that only one car approached on the cross street. It will be noticed that after right of way has been showing on the highway for a certain length of time, right of way is immediately callable to the cross street, should a vehicle approach there. But if a vehicle should approach on the cross street at any time after the cross street has lost right of way, and before right of way has been given to the highway for a certain minimum length of time, relay 114 will operate and lock in, closing the discharge circuit of condenser 109, but, no discharging of condenser 109 can take place until it has been charged to the critical voltage of tube 110, and this cannot take place until right of way has been showing on the highway for the certain minimum length of time governed by the value of resistance 105.

If right of way has been transferred to the cross street in response to a vehicle approaching there, and a second vehicle approaches on the cross street before the end of the 7 second period which is timed in position C, relay 114 will operate, causing armature 132 to touch contact 135, which shunts resistance 136 across the terminals of condenser 126, at the same time interrupting the charging circuit of condenser 126. Referring again to Figure 2, it will be noticed that the length of time circuit between wires 10 and 11 remains closed depends entirely upon the length of time the wheel of the vehicle is on ramp 5. And this again depends entirely upon the speed of the vehicle. The slower the vehicle is traveling, the longer is this length of time, and the faster the vehicle is traveling, the shorter is this length of time. Consequently, adjustable resistance 136 is shunted across the terminals of condenser 126 for a period of time dependent entirely upon the speed of the vehicle operating relay 114. If the vehicle is moving slowly, this time will be long and practically all of the energy stored in condenser 126 will be dissipated in resistance 136, and thus when the energizing circuit is re-established, charging of condenser 126 will start with practically no stored energy in the condenser, and the time required to charge it up to the critical voltage of tube 127 will be practically 7 seconds. If the vehicle is traveling fast, the time of discharge, and consequently the amount of discharge will be small. Thus, when the energizing circuit is re-established, charging of condenser 126 will start with some remaining stored energy, and the period timed will be the period necessary to charge condenser 126 from the voltage existing at that moment to the critical voltage of tube 127. The time period will be shorter by the amount of time that would have

been necessary to charge condenser 126 from zero voltage to the voltage to which it had been reset. Thus it appears that the amount of reset depends upon the length of time the energizing circuit is interrupted.

The above is the action of the apparatus if the energizing circuit is always interrupted when condenser 126 has been charged to some particular voltage. In practice, as will appear later, the interrupting of the energizing circuit may occur at all sorts of different voltages. Considering the operation of the device more in detail, it will appear that the actual amount of discharge, while dependent upon the length of time the energizing circuit is interrupted, also depends upon the voltage to which condenser 126 had been charged when the energizing circuit was interrupted. Thus for a resetting impulse of a certain length of time, the amount of reset is proportional to the voltage existing at the moment when resetting started. It thus appears that while the first vehicle on the cross street receives a full 7 seconds, subsequent vehicles receive a period which depends upon their speed and, consequently receive protection periods which correspond to the speed at which they are traveling. The faster the vehicle travels, the less the reset and consequently the less is the time given the vehicle. But, the faster the vehicle travels, the less time it needs.

The above would be the action if succeeding vehicles continually approach just before condenser 126 is about to discharge. In practice, traffic rarely approaches in just that way. For example, the second vehicle may approach within a second or two from the time the first approached, and, if there were no resetting at all, the second vehicle might receive 5 or 6 seconds in which to cross the intersection, which might be ample. The apparatus automatically takes care of just such a condition. If the second vehicle approaches, say after 2 seconds, condenser 126 will have been energized for only 2 seconds and the voltage it has reached will be quite small. Consequently, the amount of reset will be very small, and the additional time given above the time it would receive were there no reset at all, would be small. If the second car approached after 5 or 6 seconds, the voltage of condenser 126 would be large, the amount of reset large, and the additional time given, large. Thus there is provided a mechanism which very efficiently provides a protection period in accord with the speed of the vehicle.

As soon as traffic ceases to approach on B street, condenser 126 will be permitted to charge to the critical break-down voltage of tube 127 and will there discharge through tube 127, notching or advancing the cams to position D, and from then on the operation is as described above.

Should vehicles approach continuously on B street, continually resetting condenser 126, right of way would remain indefinitely on the cross street to the disadvantage of the highway unless some limitation is imposed upon the length of time the cross street may retain right of way. It will be noticed that in position C, contact 64 is closed which allows charging current to flow into condenser 109 through resistance 137. Assume that resistance 137 is so adjusted that condenser 109 will reach the critical voltage of tube 110 in 20 seconds. This condenser is not reset by approaching vehicles, and if traffic continues at the end of 20 seconds, condenser 109 will discharge through tube 110, operating relay 97 which energizes magnet 29, and the mechanism notches to position D as described previously. The difference is that relay 97 also operates armature 138 which touches contact 139 which allows current to flow through relay 114, operating it. The energizing circuit made at armature 138 is only momentarily closed and relay 114 would not remain energized, (its locking circuit being broken at contact 62) were it not for contact device 93 which is made as soon as notching mechanism 26 begins to move. This completes circuit between wires 78 and 79 which provides a temporary locking circuit. Contact 62 is made in position D and as a matter of fact, is made slightly before solenoid 29 becomes fully de-energized, and is so adjusted that contact 62 is made just before circuit between wires 78 and 79 is broken, maintaining relay 114 in an energized position. Thus, while some vehicles have lost right of way before they have had sufficient time to cross the intersection, the system remains in such a condition that without requiring any additional actuation of the B street vehicle actuated device, right of way will revert to B street at the end of the highway right of way period.

It will be noticed that right of way is being given to B street in position B although the resettable timer has not begun to operate. This period, in this case 3 seconds, is the period provided to allow one or more vehicles which may be waiting on B street to get into motion, and presumably the last of such waiting vehicles is actually in motion when the mechanism notches the cams to position C.

If no vehicles are waiting on B street, right of way will be given to the highway and may remain there indefinitely, thus preventing pedestrians from crossing the highway. It is desirable to provide a system which will occasionally shift right of way to the cross street even though there are no vehicles waiting thereon, stopping highway traffic and allowing pedestrians to cross the highway. This is accomplished through contact 66 which is made in position F. This charges condenser 126 through resistance 139, and this resistance is adjusted so that condenser 126 is charged to the critical voltage of tube 127 in 2 minutes. This notches the cams to position A and from then on they automatically advance themselves through the succeeding positions. Of course, should vehicles approach while cams are in position C, they will reset condenser 126, as described previously. But if no vehicles at all approach, right of way will shortly be returned to the highway and highway traffic may proceed.

In describing the operation of the system, we have shown the device as exhibiting the signal lights in the usual sequence, namely, green, yellow, red, yellow, green. It frequently is desirable to omit the showing of yellow when the shift is from red to green, and continue to show a red light while a yellow light is being given to the street which is losing right of way. This can be easily accomplished by providing that the cam under contact 57 operates the contact only in position A, that the cam under contact 58 operates the contact through positions B, C, and D, that the cam under contact 59 operates the contact through positions E, F and A, and that the cam under contact 60 operates the contact in position D only, obviously by suitable arrangement of the cams any other desired signal sequence may be obtained.

If it is desired to omit the increment on the cross street, this may be accomplished by omit-

ting position B, in which case, of course, only 15 teeth per revolution of the cams would be required. Position E is provided for certain reasons which will be explained later. Suffice it to say at the moment that if position B is omitted, position E may be conveniently omitted also, and thus only 12 teeth per revolution would be required. In a similar way any desired amber period may be omitted by constructing the cams without that particular position. It is to be noticed that one revolution of the cams provides three complete signal cycles. The reason for choosing this particular arrangement will appear later, but as a matter of fact the cams can be constructed so that two complete cycles are given per revolution, or any desired number.

Contacts **62** and **63** both remain closed during 5 positions. The only difference between the two is that the two contacts are three positions out of step. In other words, contact **62** is broken three positions ahead of the time contact **63** is broken, which is, of course, one-half a cycle, a cycle being six positions. Referring now to Figure 6, it will be noticed that if a second contact structure **142** is mounted at the bottom of the cam, one cam can be used to operate two contacts, the only difference being that the lower contact is one-half a cycle out of step with the upper contact. It now appears that instead of using one cam, for contact **62**, and another cam for contact **63**, by arranging the contacts as shown in Figure 6, one cam can be made to do the work of two. It will furthermore be noticed that cams **64** and **65** can be paired in the same fashion, also contacts **66** and **71**, contacts **67** and **68**, contacts **69** and **70**, contacts **56** and **58**, contacts **59** and **61**, and contacts **57** and **60**. Although the number of contacts is not changed, only one-half the number of cams need be used. The number of positions per cycle in this case is six, and therefore the upper and lower contacts of each cam can be displaced by one-half cycle, and if, in addition, the number of cycles per revolution is an odd number, the upper and lower contacts may be mounted parallel. This is the purpose of position E, namely, to provide an even number of positions per cycle. Of course as long as the number of cycles per revolution is an odd number, the contacts may be mounted parallel. If only one cycle per revolution were used, the notching mechanism would have to advance the cams 60 degrees per step, which introduces mechanical difficulties. With three cycles per revolution, the amount advanced per step is only 20 degrees, which can be accomplished easily. A further interesting feature of this device is the way in which any one time period may be adjusted. Consider, for example the minimum right of way period given to the highway. This is controlled by resistance **105**. Fig. 10 shows the details of this resistance which, of course, may be duplicated in each instance—if desired. It will be noticed that resistance **105** may be made up of several small resistors **106'** placed in series. It is a well known fact that if the supply voltage remains constant and the condenser does not change, then the period required to reach the critical voltage will be proportional to the charging resistance. Each individual resistance may be of such a value that if it alone is in the charging circuit, 10 seconds are required to charge the condenser to the critical voltage. Then if two are in series, 20 seconds will be required. If three are in series, 30 seconds will be required, and so on. By providing an ordinary rotary switch **107**, which can be moved on to any one of several contacts **108**, each of which has a tap wire **109** leading to the junction between the individual small resistors **106**, the time period may be varied by simply moving this switch manually by means of a dial which may be marked with the various settings. Obviously, the increase from step to step need not be 10 seconds, but can be any other desired value.

It will be understood from the above description of the apparatus and its operation thru a cycle that the time element represented by Figure 3 or any other suitable timing element is employed successively in different positions of the cam shaft to time the interval before the cam shaft is shifted to its next position. The cam operated contacts or other suitably operated contacts upon each shift of the shaft from one position to another connect a suitable operating circuit including appropriate resistance as illustrated in this embodiment of the invention to control the time period of the timer. Thus the condenser timer of Figure 3 serves as a single timing element or timing means which is employed for different types of timing functions and various independently adjustable time intervals thru the cam contacts which it causes to operate at the end of each of its time intervals. The solenoid and ratchet mechanism or other suitable cam shaft operating means resets this single timing element each time it operates at the completion of a time interval to prepare it to start its next time interval the moment that the cam shaft has been shifted into the next position. In the present embodiment two such single timing elements are employed in order to care for the two different timing functions concurrently active particularly in positions C and F of the cam shaft but it will be clear to those skilled in the art that the employment in accordance with the invention of a single timing unit to operate a multi-circuit controlling mechanism, which in itself besides controlling work circuits also changes the functions of the timer and provides a new operating circuit for it with independent adjustment of its time interval in successive positions of the circuit controlling mechanism, provides a very flexible time control mechanism. Especially with an electrostatic timer of the type disclosed in this embodiment or any suitable modification or substitute for the same which will be apparent to those skilled in the art, a time controlled switching mechanism is made available in accordance with this invention which minimizes the number of moving parts and permits such parts to be made of simple, rugged construction and also provides a wide range of convenient time adjustment.

From the foregoing, it will be seen that by means of the present invention, a traffic control system is provided which will function so:

1. That in the absence of traffic on the cross street, right of way is normally shown in favor of the highway.

2. That a vehicle approaching on the cross street transfers right of way to the cross street.

3. That a vehicle which has passed an actuating means is protected against opposing traffic for a period of time sufficient to permit said vehicle to pass the intersection of the traffic lanes.

4. That continuous traffic on the cross street will not retain right of way to the disadvantage of the highway for more than a certain period.

5. That when a vehicle is not given immediate right of way, the system will be left in such a

condition that right of way will be given to it as soon as traffic conditions permit.

6. That when a vehicle has right of way taken from it before it has had sufficient time to cross the intersection, the system will be left in such a condition that right of way will re-turn to the delayed vehicle as soon as traffic conditions permit.

7. That whenever right of way is given to the highway, it must remain there for at least a certain length of time.

8. That periodically right of way shifts to the cross street even though there be no vehicular traffic on the cross street, in order to allow pedestrians to cross the intersection.

9. That the signal means may be disconnected from the traffic actuated means and be operated manually.

10. That a warning signal may be interposed between right of way and stop signals.

11. That each vehicle approaching a right of way signal is protected against opposing traffic for a period commensurate with its speed.

12. That if one or more vehicles, after passing the actuating means, do not receive right of way immediately they will be protected against opposing traffic when they do receive right of way, for an additional period of time sufficient to allow the last of the waiting vehicles to get started.

It will be understood that by means of the present invention, it is only necessary to provide vehicle actuated controls in a single vehicle lane. Moreover, as shown, the right of way when once transferred to the highway remains in favor of the highway for a sufficient period of time to clear up or at least relieve any accumulation of traffic on the highway incident to the transfer of right of way to the cross street. This will occur despite the fact that vehicles even after the expiration of the maximum timing period in favor of the cross street are still awaiting right of way on the latter. However, the timing mechanism provided to achieve this result might obviously be modified in certain respects in order that its improved construction might be accommodated to other types of traffic control systems.

Moreover, it will be seen in connection with the factor of safety and control provided by the present system and viewing the same from one angle that not alone does the system take into account the fact that the vehicles approaching the intersection must be accorded a time interval to negotiate the intersection additional to preceding vehicles which have actuated the control, but the resetting by means of which this factor is allowed for will be proportional to the speed of the vehicle. Viewing another aspect of the invention, it will be observed that the system takes into account in the case of a line of vehicles awaiting right of way and all of which have actuated the control that the latter vehicles of this group—incident to getting into motion and allowing for proper spacing between vehicles—will need a period of time additional to the minimum required in the case of a single vehicle which is in continuous motion from the time it actuates the control until it completely negotiates the intersection. Also, in the absence of transfer of right of way from the highway to the cross street—as would occur normally if there were no vehicles awaiting right of way on the latter—the system will take into account the needs of pedestrians in order periodically to interrupt the right of way on the highway. It will be additionally understood that while the present system provides a warning at the time of transfer of right of way, that this warning need not necessarily be accorded in the specific manner shown, although preferably an amber or equivalent signal will be furnished. For example, a blank period might in certain instances serve this purpose while in other instances, if a red or "Stop" indication were simultaneously accorded, both vehicle lanes at the time of transfer of right of way, this might be adequate.

In connection with the manual operation of the system under point 9 aforemade, it will be understood that this is achieved by opening switch 140 and thus disconnecting the timing mechanism from the lights. Thus the lights may be operated manually by simply pressing push button 141 which upon each functioning energizes magnet 29 thus advancing the cams through their cycle and in so doing transfer right of way from one vehicle lane to the other.

Obviously any number of changes and rearrangements of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

Having described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. A traffic control system for two interfering traffic lanes including in combination signalling means for according and interrupting right-of-way in said lanes, a timer connected to said signalling means to control the same, traffic-actuated means in one of said lanes, said timer including means, when conditioned operating for transferring right-of-way to the lane of said traffic-actuated means in response to actuation of said traffic-actuated means and automatically re-transferring right-of-way to the second lane thereafter, means for automatically transferring right-of-way from said second lane a predetermined maximum period after it is accorded, means for maintaining right-of-way in said second lane for a predetermined minimum period less than said maximum and at the end of said minimum period so conditioning the second means for immediately transferring right-of-way only after said minimum and before said maximum in response to actuation by traffic in the lane of said traffic actuated means.

2. A traffic control system for two interfering traffic lanes including in combination signalling means adapted to accord and interrupt right-of-way to said lanes, a traffic-actuated device in one of said lanes, a timer connected to said signalling means and to said traffic-actuated device to control said signalling means in cooperation with said traffic-actuated device, said timer including means, when conditioned functioning in response to operation of said traffic-actuated device to cause said signalling means to accord right-of-way to the lane of said traffic-actuated device for a minimum period and thereafter to accord right-of-way to the other lane and also including two timing devices for timing the period of right-of-way on said other lane, one timing device providing a minimum period, immediately after which it conditions the second means so that another operation of said traffic-actuated device can cause transfer of right-of-way from said other lane to the lane of said device, and the other timing device providing a maximum period of right-of-way longer than said minimum after which maximum the right-of-way is automatically transferred to the lane of said traffic-actu-

ated device in the absence of actuation of said device.

3. A traffic control system for two interfering traffic lanes including in combination signalling means for according and interrupting right of way in said lanes, a timer connected to said signalling means to control transfer of right of way by the same, traffic actuated means in one of said lanes only, control means forming a part of said timer and acting when operable to cause in response to actuation of said traffic actuated means when the right of way is on the second lane the immediate transfer of right of way to the first lane, means in said timer for retransferring right of way to said second lane within a predetermined maximum period thereafter, timing means to maintain right of way on said second lane for a predetermined minimum period and thereupon to make said control means operable for such response to actuation and means forming a part of said timer to cause automatic transfer of right of way to said first lane after a predetermined maximum period of right of way in said second lane longer than the minimum in the same lane and during which there is no actuation on said one lane.

4. A system for controlling traffic, including signalling means to be visible to traffic approaching over either of two intersecting lanes, a timer connected to said signalling means and operating cyclically to transfer right of way indication by said signalling means from one lane to the other lane after the right of way has endured in said one lane for a maximum period of time, means forming a part of said timer to retransfer right of way from said second lane to said first lane after right of way has endured in the second lane for a certain period of time, said system including a traffic actuatable controller to be disposed solely for use by traffic approaching the intersection over the second lane and connected to said timer to cause transfer of right of way from said first lane to said second lane, and means forming a part of said system and preventing transfer of right of way from the first lane to the second lane and in response to controller actuation until the right of way in the first lane has endured for at least a minimum period less than said maximum, said last named means including a timing device comprising a condenser, means for charging the condenser, means connectible to said condenser and acting responsive to a predetermined charge when connected to said condenser to cause transfer of right-of-way from said first lane by said signal and means responsive to controller actuation to connect said charge responsive means to said condenser.

5. A traffic control system for two interfering traffic lanes including in combination signalling means to accord and interrupt right of way in said lanes, traffic actuated means in one of said lanes only, a time controlled switching mechanism for normally operating said signalling means to accord right of way cyclically for a minimum period to the lane of said traffic actuated means and for a maximum period to the other lane in the absence of actuation of said traffic actuated means, means when conditioned operable upon actuation of said traffic actuated means while right of way is accorded to said other lane to interrupt the normal cyclic timing and substantially immediately cause transfer of right of way to the lane of said traffic actuated means, and means forming a part of said time controlled switching mechanism to prevent such interruption and transfer until right of way has been accorded to said other lane for at least a predetermined minimum period and then to condition the third means to permit such interruption and transfer thereafter up to said maximum period.

6. A traffic control system for two interfering traffic lanes including in combination signalling means to accord and interrupt right of way in said lanes, traffic actuated means in one of said lanes only, a time controlled switching mechanism for normally operating said signalling means to accord right of way cyclically for a minimum period to the lane of said traffic actuated means and for a maximum period to the other lane in the absence of actuation of said traffic actuated means, means when conditioned operable upon actuation of said traffic actuated means while right of way is accorded to said other lane to interrupt the normal cyclic timing and substantially immediately cause transfer of right of way to the lane of said traffic actuated means, and means forming a part of said time controlled switching mechanism to prevent such interruption and transfer until right of way has been accorded to said other lane for at least a predetermined minimum period and then so condition the third means until right of way is transferred from said other lane, further means forming a part of said mechanism and operable upon actuation of said traffic actuated means while right of way is accorded to the lane of the latter to interrupt the normal cyclic timing and prolong right of way on that lane.

7. A traffic control system for two interfering traffic lanes including in combination signalling means to accord and interrupt right of way in said lanes, traffic actuated means in one of said lanes only, a time controlled switching mechanism for normally operating said signalling means to accord right of way cyclically for a minimum period to the lane of the said traffic actuated means and for a maximum period to the other lane in the absence of actuation of said traffic actuated means, means when conditioned operable upon actuation of said traffic actuated means while right of way is accorded to said other lane to interrupt the normal cyclic timing and substantially immediately cause transfer of right of way to the lane of said traffic actuated means, and means forming a part of said time controlled switching mechanism to prevent such interruption and transfer until right of way has been accorded to said other lane for at least a predetermined minimum period and then so condition the third means until right of way is transferred from said other lane, further means forming a part of said mechanism and operable upon actuation of said traffic actuated means while right of way is accorded to the lane of the latter to interrupt the normal cyclic timing and prolong right of way on that lane, additional means forming a part of said mechanism to prevent prolongation by such traffic actuated means of right of way in its lane beyond a predetermined maximum period of right of way.

8. A traffic control system for two interfering traffic lanes including in combination signalling means adapted to accord and interrupt right-of-way to said lanes, a traffic-actuated device in one of said lanes, a timer connected to said signalling means and to said traffic-actuated device to control said signalling means in cooperation with said traffic-actuated device, said timer including means functioning in response

to operation of said traffic-actuated device to cause said signalling means to accord right-of-way to the lane of said traffic-actuated device for a minimum period and thereafter to accord right-of-way to the other lane and also including two timing devices for timing the period of right-of-way on said other lane, one timing device providing a minimum period before another operation of said traffic-actuated device can cause removal of right-of-way from said other lane, and the other timing device providing a maximum period of right-of-way longer than said minimum, after which right-of-way is automatically transferred to the lane of said traffic-actuated device, said first timing device comprising a condenser, means for charging said condenser, and control means when operable acting responsive to a charge exceeding a predetermined value on said condenser to terminate said minimum period and cause interruption of right of way in said other lane, and further means functioning in response to actuation of said traffic-actuated device to make said control means operable.

9. A traffic control system for two interfering traffic lanes including in combination signalling means adapted to accord and interrupt right-of-way to said lanes, a timer connected to said signalling means to control the same, said timer including timing means functioning upon according right-of-way on one lane to maintain it in said lane for a predetermined minimum period, said timing means comprising a condenser, means for charging said condenser, control means connectible to said condenser for causing interruption of right-of-way upon the charge on said condenser exceeding a predetermined value, a traffic-actuated device in the other lane, and means to connect said control means to said condenser upon operation of said traffic-actuated device.

10. A traffic control system for a plurality of interfering traffic lanes including in combination signalling means adapted to accord and interrupt right of way to said lanes, a time controlled switching means for controlling said signalling means to transfer right of way between said lanes and to accord right of way to one lane at a time, timing means for controlling said switching means and functioning when right of way is accorded to one lane to maintain it in said lane for a predetermined minimum period before transfer to a second lane, said timing means comprising a condenser, means for varying the charge on the condenser from an initial value toward a final value, control means connectible to said condenser for causing operation of said switching means to cause the signalling means to transfer right of way from said one lane to the second lane upon the charge on said condenser reaching a predetermined value between said initial value and said final value, traffic actuated means in said second lane, and means to connect said control means to said condenser upon operation of said traffic actuated means.

11. A traffic control system for two interfering traffic lanes including in combination signalling means adapted to accord and interrupt right-of-way to said lanes, a timer connected to said signalling means to control the same, said timer including timing means functioning upon according of right-of-way to one lane to maintain it in said lane for a predetermined minimum period, said timing means comprising a condenser, a charging circuit connected to said condenser, an electronic tube having a threshold conducting voltage and a relay in series and connectible to said condenser to operate said relay upon the charge on said condenser exceeding the said threshold voltage, means responsive to operation of said relay to cause said signal to interrupt right-of-way in said one lane, traffic-actuated means in the other lane, and means to connect said tube and relay to said condenser in response to operation of said traffic-actuated means.

12. A traffic control system including in combination signalling means for displaying indications for the control of traffic at an intersection of traffic lanes, means connected to said signal to control the same, a source of electrical current supply, a condenser, a plurality of circuits connectible to said source of current supply and including means to charge said condenser at different rates, means for selectively coupling one of said circuits to said condenser to charge the same, traffic-actuated means in one of said lanes, means when operable functioning upon said condenser being charged to a predetermined extent to operate said signal controlling means to cause a change of signal and to operate said selective coupling means to couple another of said circuits to said condenser, and a means responsive to actuation of said traffic-actuated means to make said charge responsive means operable.

13. A traffic control system including in combination signalling means arranged at the intersection of traffic lanes and adapted to display indications for the control of traffic in said lanes, traffic-actuated means in one of said lanes, time controlled means connected to said signalling means and to said traffic-actuated means for causing said signal to indicate right-of-way to the lane of said traffic-actuated means in response to actuation of said traffic-actuated means, said time controlled means including a condenser, a condenser charging means, a condenser discharging means, means connected to said condenser and acting responsive to a predetermined charge on said condenser to operate said signal to interrupt said right-of-way and to change the time rate of charge of said condenser, and means functioning upon operation of said traffic-actuated means while said right-of-way is accorded to its lane to operate said condenser discharging means so as to extend the period of right-of-way.

14. In a traffic signal control apparatus for control of right of way at the intersection of a plurality of traffic lanes having a signal and means for operating said signal responsive to traffic in at least one lane, the combination of switching mechanism having a plurality of different positions for operating the signal to display the different control indications, a condenser, means normally operable for varying the charge on said condenser from an initial level toward a final level, means responsive to the charge on said condenser reaching a predetermined level between said initial and final levels to operate said switching mechanism from one position to another, reset means acting when operable to render ineffective said normally operable charge varying means and to vary the charge on said condenser away from said final level and toward said initial level, and means forming a part of said switching mechanism to connect said reset means for operation responsive to actuation of the traffic responsive means when said switching means is in one position in which right-of-way is accorded to the lane of such traf-

fic responsive means and to disconnect said means at other times.

15. Traffic signal control apparatus for providing a cycle of right-of-way control for a plurality of interfering traffic lanes having means operable responsive to traffic in at least one lane said apparatus comprising in combination mechanism adapted to be operated through a cycle to accord right of way successively to said lanes, a single timing device for timing the operation of said mechanism in certain parts of such cycle, one circuit means and a switch therein connectible for operating said timing device to provide for one part of such cycle a time interval variable by operation of the traffic responsive means, a second circuit means and switch therein connectible for operating said timing device to provide for another part of such cycle a non-variable time interval, and means operated by said timing device only upon completion of its time interval to operate said mechanism from one part of the cycle to the other and concurrently operate said switches to change between such circuit means.

16. A traffic control system for interfering traffic lanes including in combination a signalling means for according and interrupting right-of-way in said lanes, a timer connected to said signal to control the same, traffic actuated means in one of said lanes and connected to said timer, said timer including a rotary switching mechanism having a plurality of timed positions for operating the signal to accord and interrupt right-of-way in the lanes, a timing device connected with said mechanism to govern the time it is in each of such positions and to operate said mechanism from each position to the next at the end of such time, said switching mechanism cooperating with said timing device to cause accord of right-of-way through two of such positions to the lane of said traffic actuated means in response to actuation of such means and to provide a predetermined minimum period of such accord of right-of-way in the last named lane in one of such positions and then to shift to an immediately following position in which it provides a further right of way period in said last named lane, and means forming a part of said switching mechanism for rendering only said further period variable by actuation of said traffic actuated means during said further period.

17. In an electrical timing apparatus for controlling work circuits, the combination of a condenser, one circuit for connecting said condenser to a source of power to charge the condenser at a certain time rate, a second circuit for connecting said condenser to the same source of power for charging the condenser at a different time rate, switching means connected with said circuits, and means responsive to said condenser being charged by one of said circuits to a predetermined extent to operate said switching means to connect the other circuit.

18. In an electrical timing apparatus for controlling work circuits the combination of a condenser, means including a circuit and a switch therein for connecting said condenser to a source of power to charge the condenser at a certain time rate, means including a second circuit and switch therein for connecting said condenser to the same source of power for charging the condenser at a different time rate, switching means for actuating said switches to connect one of said circuits at a time to said condenser and means connected to said condenser and operating when the condenser is charged to a predetermined extent to operate said switching means.

19. In a timing apparatus, the combination of an electrical current supply, a condenser, a plurality of circuits connectible to said condenser to charge the same at different time rates, switching means forming a part of said circuits, a shaft and means operated thereby for operating said switching means to successively connect and disconnect said circuits upon rotation of said shaft, an electronic tube having a threshold conducting voltage, a relay connected to said tube and operable upon said tube becoming conducting, said relay and tube being connected across said condenser, and means operated by operation of said relay to rotate said shaft.

20. In a timing apparatus the combination of a source of electric power, a condenser, an electronic tube adapted to pass current only when the voltage across its terminals exceeds a certain critical value, a relay in series with said tube in shunt with said condenser and adapted to be operated when said tube passes current responsive to voltage across the condenser exceeding said critical value, a plurality of control circuits each including a resistance and a circuit closer and arranged when closed to be connected between said supply and said condenser to vary the voltage thereon over a time interval, a shaft and means operated thereby cooperating with said circuit closer and operable during one phase of rotation of said shaft to close one of said control circuits and open the others and during another phase of rotation to open said one circuit and close one of the others, and means operated by operation of said relay to rotate said shaft from one phase to another.

21. In an apparatus for the control of work circuits thru a time cycle of operations, the combination of an electrical power supply, a condenser, a plurality of control circuits including switching means and connectible to said condenser to vary at different time rates the charge on the same from an initial level toward a final level, mechanism having a series of more than two positions corresponding to such cycle of operations and adapted to cyclically operate said switching means successively to connect and disconnect said control circuits in said series of positions, an electronic tube connected to said condenser so as to pass substantial current only upon the charge on said condenser reaching a certain level, a relay connected to said tube and condenser and operated by said tube passing substantial current and means operated by operation of said relay to operate said mechanism from one position to the next in said series.

22. In a time controlled switching apparatus for controlling work circuits through a time cycle of operations, the combination of switching means having a plurality of contacts and adapted to be operated cyclically through more than two contact positions in sequence, a condenser, a plurality of control circuits for said condenser and including means to vary the charge on said condenser at different time rates from an initial value to a different predetermined value, means including certain of said contacts for selectively coupling one of said control circuits at a time to said condenser to charge the same in the several positions, and means operating upon the charge on said condenser reaching said predetermined value to operate said switching means from one contact position to another whereby the selective coupling

means will couple another of said control circuits to said condenser.

23. In a timer for operating work circuits in a sequence of operations at time periods, the combination of a rotary switching mechanism having more than two positions and switches operated therein, a condenser, means for varying the charge on said condenser from an initial value to a different predetermined value to determine the time period in one of such positions, charge responsive means operable upon the charge on said condenser reaching said predetermined value to terminate said time period and to shift said switching means from said one position to the next position, and means forming a part of said charge responsive means and operating as said switching means is shifted to reset said condenser charge to its initial value to prepare the condenser for timing the next period.

24. In a controller for operating work circuits through a sequence of operations, the combination of a rotary step-by-step switching means having a plurality of contact positions, a single timing device adapted to be operated from a normal starting condition over a time interval to a time interval completion condition to determine a time period for said switching device in each of such positions, said timing device adapted to be reset to its starting condition from any other condition including said time completion condition, a plurality of operating circuits for said timing device and including means in the circuits operated by said switching means to operate said timing device to time periods of different time lengths in the several positions, means for so resetting said timing device and means operable by said timing device in its time completion condition to operate said switching means from one position to another so as to change between such circuits to change the time interval and to operate momentarily said resetting means to prepare the timing device for timing the latter position.

25. In a time controlled switching apparatus for controlling work circuits through a time cycle of operation, the combination of switching means, a rotatable shaft and means operated thereby to operate said switching means, said shaft having a plurality of operating positions, a ratchet wheel mounted on said shaft, a solenoid and means operated thereby for engaging said ratchet wheel to rotate said shaft from one position to another, an electric condenser, means for varying the charge on said condenser over a time period from an initial value to a different predetermined value to determine the time interval in such positions, means operating responsive to the charge on said condenser reaching said predetermined value to operate said solenoid, and means operated by operation of said solenoid to restore the charge on said condenser substantially to said initial value.

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