

Jan. 23, 1934.

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1,944,723

CONTROL FOR TRAFFIC SIGNAL SYSTEMS

Filed April 15, 1930

Fig. 1.

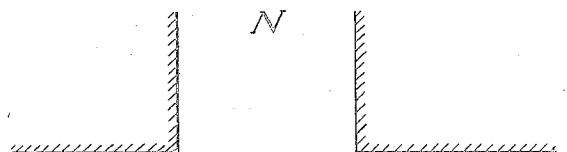
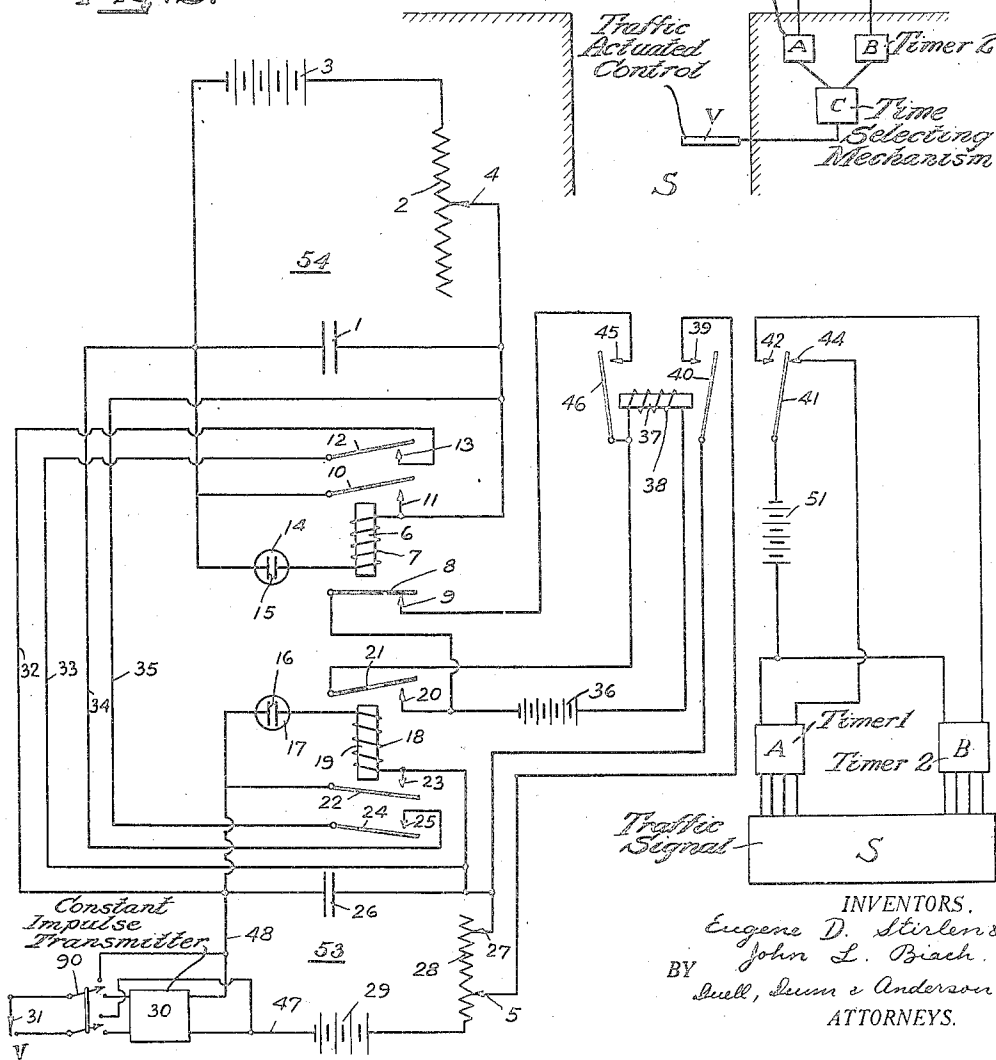


Fig. 2.



UNITED STATES PATENT OFFICE

1,944,723

CONTROL FOR TRAFFIC SIGNAL SYSTEMS

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Application April 15, 1930. Serial No. 444,463

12 Claims. (Cl. 177—337)

This invention relates to a functionally and structurally improved control capable of use in numerous different associations but primarily intended for employment with a traffic control system.

It is a well appreciated fact that considerable difficulty has been experienced in connection with traffic control systems in that the mechanisms of these systems have been set to periodically transfer right of way from one street or series of streets to another street or series of streets, and the setting of the mechanism for establishing this transfer has been made according to predetermined conditions which largely have had to be approximated. In other words, presuming that street A is determined as having a major volume of traffic and street B a minor traffic volume, the apparatus has been set for example to give right of way to vehicle lane provided by street A for a period of forty seconds and then transferred this right of way for a period of twenty seconds to the vehicle lane provided by street B, this cycle being continued. This setting might function with entire satisfaction for many hours during the day, but under unusual conditions where a major portion of the traffic would be traversing the vehicle lane provided by street B, the traffic control system instead of expediting the passage of traffic would, according to this previous setting, be impeding the same. Of course, other instances of difficulty occur where for example during certain hours of the day a major portion of the traffic would desire to make a turn into a side street, whereas during the remainder of the day, the traffic flow would continue to pass this street without turning. Again, according to previous arrangements in traffic control systems, it would either be necessary to approximate general conditions or else to periodically and manually reset the apparatus to approximate for a time period of several hours a second set of conditions, and then to reset the apparatus to the initial condition.

It is an object of the present invention to provide an automatic traffic controlled system which will function in response to the density of traffic flow so that as variations occur, the system will function in response to conditions as they exist, thereby expediting the flow of traffic.

A further object of the invention is that of providing an apparatus capable of performing these functions and which will embrace relatively few parts, each individually simple in construction and sufficiently rugged to withstand for indefinite periods the use to which it would be subjected,

this apparatus being capable of compact assemblage to provide units functioning over long periods of time with freedom from mechanical and electrical difficulties.

A still further object is that of providing a system of this character in which not alone varying conditions of traffic may be approximated and automatically provided for in the functioning of the system, but in which additionally the functioning of the apparatus may be adjusted to allow for still further modifications of this factor.

An additional object is that of providing a layout of apparatus furnishing a system of this nature and which will embody a minimum of moving parts so that difficulties incident to wear and servicing will be reduced to a minimum.

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

Fig. 1 illustrates diagrammatically a street intersection and control mechanism associated therewith;

Fig. 2 is a similar view showing in detail the layout of this mechanism.

One example of a street intersection is shown in Fig. 1. This is an intersection commonly known as a cross type intersection. When traffic is light, or of medium density, we shall assume that most of it desires to move straight through the intersection, and consequently few vehicles desire to turn left into the intersecting street. When this condition prevails, experience has shown that the most efficient type of control is a so-called two-phase system. This gives the "go" signal to the north-south street for a certain length of time while giving the "stop" signal to the east-west street. It then reverses these indications for a certain length of time. S represents the right of way signal, and A a controlling mechanism for operating signal S on a two-phase system.

At certain times of the day, however, the traffic approaching on the south becomes very heavy, and, furthermore, most of this traffic desires to turn left into the west approach. If operated on a two-phase system, the north and south approaches would receive the "go" signal simultaneously. The vehicles on the north approach, desiring to go straight through, and the vehicles on the south approach, desiring to turn left, would interfere, and unless traffic is handled on a different system these two interfering flows would soon block up the entire intersection and the movement of traffic would be very slow and

inefficient. This condition is best handled on a so-called three phase system. In the latter, phase 1 would give the "go" signal to the east-west street. Phase 2 would give the "go" signal only to the north approach, and traffic there could proceed through the intersection without interference. Phase 3 would give the "go" signal only to the south approach, and vehicles on the south approach would thus be able to turn left into the west approach without being forced to pass through traffic coming from the north approach. Controlling mechanism B is provided for operating the right of way signal S on a three-phase system.

Another problem which might well arise is that which has been first outlined among the difficulties heretofore encountered in connection with systems. In other words, let us presume that the east-west street is the street which ordinarily should be considered in the light of traffic conditions as the one of major dignity, while the north-south street is the one which under these conditions will have a less degree of importance. Under these circumstances, it might be desired to accord to east-west a right of way under normal condition a sixty second period and to transfer this right of way to the north-south vehicle lane for a period of only thirty seconds. To this end, timer A might control this operation. However, there may be certain periods of the day where conditions will be reversed along the two vehicle lanes or where for example they are to be given equal dignity in so far as the right of way interval is concerned, and timer B might control this setting and the consequent operation of the signal.

In another instance, of course, the timers may be of any desired construction and the system might be of any desired type, the present invention being primarily directed to the thought of providing an apparatus whereby cognizance of the changes in traffic conditions will be had and the apparatus will adjust its functionings according to these conditions.

It is, however, regardless of the conditions which one seeks to approximate and the consequent setting of the timers, necessary to provide a mechanism that is able to ascertain the volume of traffic and choose either of the two controlling mechanisms, A or B. This mechanism is represented by C, and its wiring diagram is shown in Figure 2.

Since the determining factor is the flow of traffic on the south approach, a vehicle actuated device V would be placed in the south approach so as to be operated by passing vehicles. This vehicle actuated control may take numerous different forms and the same has not herein been illustrated in detail. One and in certain respects a preferred form includes contact elements which are normally spaced to provide a gap in a circuit, but which in response to the passage of a vehicle engage to close the circuit.

Switch 31 represents the vehicle actuated device V and, whenever operated, energizes the constant impulse transmitter 30 which may be of any desired construction so long as it closes a circuit for a predetermined period of time and in response to an actuation of the switch 31 and regardless of the period during which this switch is maintained closed. Apparatus of this character may follow various embodiments one of which, for example, might embrace the principles shown in Patent No. 1,891,735 to Oberschmidt, granted Nov. 13, 1928. Additionally, it

will be observed that a switch 90 is provided by means of which the constant impulse transmitter may be bridged. For the purpose of preliminary consideration, it is to be considered, however, that this switch is in such position that the transmitter will not be bridged. Thus, every time a vehicle operates a vehicle actuated device, circuit between wires 47 and 48 will be closed for a predetermined length of time.

Relay 37 operates armature 41. When relay 37 is de-energized armature 41 touches contact 44, energizing timer A, and the right of way signal will be operated on a two-phase system. When relay 37 is energized, armature 41 touches contact 42, energizing timer B, and the right of way will be operated on a three-phase system.

The controlling mechanism includes a counting mechanism 53 and a timing mechanism 54.

We will now describe the counting mechanism 53. Condenser 26 is in series with resistance 28, variable by means of contact 27, and battery 29. Thus, whenever the circuit between the wires 47 and 48 is closed, battery 29 will charge condenser 26 at the rate adjustable by resistance 28. The charge on the condenser will be increased by a small amount every time the circuit between wires 47 and 48 is closed, and this occurs every time a car passes. Shunted across condenser 26 is a circuit including a glow tube 17 and the winding 18 of the relay 19. This tube is of well known construction and may comprise a sealed bulb containing a suitable gas into which the electrodes 16 extend. It 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 this voltage has dropped considerably below the critical ionizing voltage. The voltage of battery 29 is greater than the critical voltage of tube 17. When the constant impulse transmitter 30 has operated a sufficient number of times to charge the condenser 26 up to the critical voltage of 17, the tube becomes conducting and the energy stored in the condenser 26 discharges through the tube 17. This discharge passes through the winding 18 of the relay 19 causing the relay to operate.

The timing mechanism 54 consists of a condenser 1 similar to condenser 26. Shunted around condenser 1 is a glow tube 14 having anodes 15, and the winding 7 of the relay 6. Glow tube 14 is similar to glow tube 17. Condenser 1 is charged through resistance 2, variable by contact 4, and battery 3. It is to be noted that condenser 1 is charged continuously, not intermittently, as is condenser 26. When condenser 1 reaches the critical voltage of tube 14, the tube becomes conducting and the energy stored in condenser 1 discharges through tube 14 and the winding 7 of relay 6 causing the relay to operate.

When relay 19 operates, it pulls in three armatures, armature 21 touching contact 20, armature 22 touching contact 23, and armature 24 touching contact 25. When armature 22 touches contact 23 it shunts condenser 26 completely discharging it. When armature 24 touches contact 25 it shunts condenser 1 through wires 34 and 35, completely discharging condenser 1. Similarly, when relay 6 operates, it pulls in three armatures, armature 12 touching contact 13, armature 10 touching contact 11, and armature 8 leaving contact 9. When armature 10 touches contact 11 it shunts condenser 1, completely dis-

charging it. When armature 12 touches contact 13 it shunts condenser 26 through wires 32 and 33, completely discharging condenser 26. The result is that whenever either condenser reaches the critical voltage of the tube shunting it, causing the relay in series with the tube to operate, both condensers become fully discharged, allowing the charging operations to start from zero.

Assume that the resistance 2 is adjusted so that condenser 1 will be charged to the critical voltage of tube 14 in one minute, and that the resistance 28 is adjusted so that condenser 26 will be charged to the critical voltage of tube 17 by the passage of 60 cars.

With the device in the position shown, the lights will be operated by timer A. As cars pass along the street, condenser 26 will get a small charge for each car. Condenser 1 will be charged continuously. Assuming traffic to remain below 60 cars per minute, condenser 1 will reach the critical voltage before condenser 26 does and so relay 6 will operate. This completely discharges both condensers and momentarily armature 8 leaves contact 9. But the circuit thus opened is also open at contact 45 and so the relay 37 remains in the position shown. This series of operations will be repeated continually until the traffic exceeds 60 cars per minute. When this happens, condenser 26 reaches the critical voltage before condenser 1 does and relay 19 will operate. Again both condensers become discharged, but armature 21 touches contact 20 for a moment completing the circuit to the winding 38 of the relay 37 and battery 36, and relay 37 operates. This pulls in armature 46 which touches contact 45 and locks relay 37 in. Armature 41 is operated by relay 37. It leaves contact 44 and touches contact 42, stopping timer A and starting timer B. Thus the system shifts from two to three phase.

It will now remain on a three phase system as long as the volume of traffic remains above 60 cars per minute. Under these circumstances, condenser 26 will always reach the critical voltage before condenser 1 reaches it, and relay 19 will operate. This will not change the position of relay 37 which remains locked in, but as soon as traffic drops below 60 cars per minute condenser 1 will reach the critical voltage before condenser 26 reaches it, and relay 6 will operate breaking the locking circuit of relay 37 when armature 8 leaves contact 9. Relay 37 returns to the position shown in the sketch and the system changes back to two phase where it will remain until the volume of traffic again exceeds 60 cars per minute.

If traffic should remain at approximately 60 cars per minute, but be slightly above that figure for one minute and slightly below the next minute, the right of way signal would be continually changing back and forth from two to three phase. It is desirable to provide apparatus which will change from two to three phase if traffic exceeds 60 cars per minute, but will not return to two phase until the traffic has dropped considerably below 60 cars per minute; for example, to 50 cars per minute. This is accomplished by means of armature 40, operated by relay 37, and contacts 40 and 5. When the system changes to three phase, armature 40 touches contact 39 and through contact 5 shunts out a portion of resistance 28. Thus, each car will charge condenser 26 more than formerly because of a reduction in the charging resistance. Contact 5 is adjusted so that 50 cars will charge condenser 26 up to

the critical voltage of tube 17. Thus, while the system is on three phase it is necessary for traffic to drop below 50 cars per minute in order to have condenser 1 reach the critical voltage before condenser 26 reaches it, and thus cause relay 6 to operate. This will deenergize relay 37 and the system returns to two phase. When relay 37 is deenergized the shunt on resistance 28 is removed and traffic will again have to exceed 60 cars per minute before the system will again change to three phase.

The above describes the operation of the device when switch 90 is in the down position. If switch 90 is thrown to the up position it will be noticed that the constant impulse transmitter is entirely disconnected, and the vehicle actuated device is connected directly between wires 47 and 48, and the charging circuit of condenser 26 is completed directly through the vehicle actuated device.

Referring again to the vehicle actuated control V designated in Fig. 2 by the reference numeral 31, it will be understood that this circuit breaker is closed to complete the circuits through the leads extending therefrom only during the time the vehicle is traversing the control. Thus, the faster a vehicle is travelling, the shorter will be the time of closing of the circuit breaker and vice versa.

With the constant impulse transmitter in use, all charging impulses are of equal length, but when the vehicle actuated device directly controls the charging of condenser 26 the charging impulses vary in length, being dependent upon the speed of the vehicle causing them. It thus becomes apparent that if, for example, the impulse from 60 vehicles travelling at 20 miles per hour will charge condenser 26 up to the critical voltage of tube 17, 30 vehicles travelling at 10 miles per hour will also charge condenser 26 up to the critical voltage of tube 17, because the total charging time is the same in each case.

Experience has shown that while an adjustment of the system may be desirable if the volume of traffic exceeds a certain amount, a change in the system may be needed fully as much with a smaller amount of traffic if the vehicles are not proceeding through the intersection with reasonable average speed, and there is thus provided by the present invention, a controlling mechanism that adjusts the system by either the volume of traffic or by the combination of volume and speed of traffic.

While the above is a preferred embodiment of our invention, it is understood that such changes as fall within the scope of the appended claims may be made. We have shown the invention connected to operate fixed timers. It is apparent that the invention could be adapted to any desired vehicle actuated traffic control system. Furthermore, while the above embodiment shows a mechanism which changes the grouping of traffic flows that are allowed to proceed simultaneously, it is apparent that the device could be used to change the cycle, the timing of a portion of the cycle, or the timing of the entire cycle, or any other change that may be necessary to more efficiently handle traffic conditions.

From the foregoing, it will be appreciated that by means of the present invention, a control is provided which is capable of use in various associations but primarily intended to be employed in conjunction with traffic systems. In this association, it may serve effectively and automatically to transfer according to the flow and/or

density of the traffic from one traffic plan to another traffic plan. These plans might of course be of any desired number and each are controlled by a suitable timing mechanism. If an apparatus of the type illustrated is provided, it will be appreciated that the number of moving parts is reduced to a minimum and that these moving parts comprise largely circuit breakers which may be arranged within the sphere of influence of electro-magnets in order to function as armatures or else only one of each group of circuit breakers may be thus arranged and may be mechanically coupled to the remainder of the group. According to this construction, while a certain traffic density will serve to maintain one plan of operation and this operation will be shifted to a second plan upon the density increasing, nevertheless, this second plan will be maintained despite the fact that the traffic flow or density may diminish unless this density falls below a predetermined minimum which may be considerably lower than that necessary to have established the initial transfer of plan. Moreover, the density of traffic is not limited to the number of vehicles, actuating the control, but may also take into account the factor of the speed of these vehicles. Accordingly, if relatively few vehicles are actuating the control during a predetermined interval of time but this low number is caused by congestion which is slowing down the flow of traffic rather than the absence of vehicles, the controller will automatically take this into account to shift to a plan of operation which will take into consideration conditions such as these.

Obviously numerous changes in construction 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. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans, a condenser, means for charging said condenser at a rate dependent upon traffic density, means acting upon the condenser being charged to a predetermined value to change the signaling plan, and means to periodically discharge said condenser.

2. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change, on change in traffic density, said mechanism including charge receiving means, means operating in response to traffic density to charge said first named means, means operable upon said first named means accumulating a charge of predetermined volume to change the then prevailing plan, and timing mechanism operating periodically to completely dissipate the accumulated charge.

3. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change on change in traffic density, said mechanism including charge receiving means, means operating in response to traffic density to charge said first named means through a series of impulses corresponding in number and interval to the volume and speed of traffic, means operable upon said first named means accumulating a charge of predetermined volume to change the then prevailing plan, and timing mechanism operating periodically to com-

pletely dissipate the accumulated charge whereby a charge of predetermined volume must accumulate prior to the functioning of said timing means to render effective a change in the then prevailing signal plan.

4. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change, on change in traffic density, said mechanism including an electrical accumulator, means functioning to charge the same, means operating upon said accumulator having received a predetermined charge to change the plan from the then prevailing signaling plan, and means for periodically discharging said accumulator.

5. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change, on change in traffic density, said mechanism including an electrical accumulator, traffic actuated means functioning to charge the same, means operating upon said accumulator having received a predetermined charge to change the plan from the then prevailing signaling plan, a second electrical charge accumulator, means for substantially constantly charging the same, and means controlled by said second accumulator to function upon its having received a predetermined charge to substantially completely dissipate the charge of said first named accumulator.

6. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change, on change in traffic density, said mechanism including an electrical accumulator, traffic actuated means functioning to charge the same, means operating upon said accumulator having received a predetermined charge to change the plan from the then prevailing signaling plan, a second electrical charge accumulator, means for substantially constantly charging the same, means controlled by said second accumulator to function upon its having received a predetermined charge to substantially completely dissipate the charge of said first named accumulator, and means controlled by said first accumulator to discharge said second accumulator.

7. In combination, a traffic signaling means operable according to any one of a plurality of signaling plans and a signal plan changing mechanism selective between said plans and dependent for effecting change, on change in traffic density, said mechanism including an electrical accumulator, traffic actuated means functioning to charge the same, means operating upon said accumulator having received a predetermined charge to change the plan from the then prevailing signaling plan, a second electrical charge accumulator, means for substantially constantly charging the same, means controlled by said second accumulator to function upon its having received a predetermined charge to substantially completely dissipate the charge of said first named accumulator, and means functioning after the operation of said first named accumulator to increase the charge intensity thereto in response to traffic density actuation.

8. A control adapted for use in a vehicle lane including, in combination, a vehicle actuated

control associated therewith, a signal for regulating the flow of traffic over said lane, a plurality of timers connectible to said signal to operate the latter, a control mechanism for coupling one or another of said timers to said signal, said mechanism being connected to said vehicle actuated control to be operated by the latter, said mechanism acting to transfer operation of said signal from one timer to another timer upon a predetermined traffic density being exceeded, and means forming a part of said mechanism to determine said traffic density as judged by both the speed and frequency of operation of said control.

9. A control adapted for use in a vehicle lane including, in combination, a vehicle actuated control associated therewith, a signal for regulating the flow of traffic over said lane, a plurality of timers connectible to said signal to operate the latter, a control mechanism for coupling any one of said timers to said signal, said mechanism being connected to said vehicle actuated control to be operated by the latter, said mechanism acting to transfer operation of said signal from one timer to another timer upon a predetermined traffic density being exceeded, and means forming a part of said mechanism and functioning solely in response to the time interval of operation of said vehicle actuated control to determine by the frequency and duration of control operation the density of traffic along said lane.

10. A control adapted for use in a vehicle lane including, in combination, a vehicle actuated control associated therewith, a signal for regulating the flow of traffic over said lane, a plurality of timer mechanisms for operating said signal, an electrical accumulator, means functioning upon said accumulator being charged to a predetermined extent to transfer signal control from one of said timers to another of the same, and means connecting said accumulator to said vehicle actuated control to charge the ac-

cumulator in proportion to the duration of the period of operation of said vehicle actuated control.

11. A control adapted for use in a vehicle lane and including, in combination, a vehicle actuated control associated with such lane, a signal for regulating the flow of traffic over said lane, a plurality of timer mechanisms for operating said signal, a control mechanism including an electrical accumulator, means functioning upon said accumulator being charged to a predetermined extent to transfer signal control from one of said timers to another of the same, and a constant impulse transmitter connected and responsive to said vehicle actuated control to charge said accumulator by a series of impulses of equal length and regardless of the periods of individual operation of said vehicle actuated control.

12. A control including, in combination, a vehicle lane, a vehicle actuated control associated therewith, a signal for regulating the flow of traffic over said lane, a plurality of timer mechanisms for operating said signal, a control mechanism including an electrical accumulator, means functioning upon said accumulator being charged to a predetermined extent to transfer signal control from one of said timers to another of the same, a constant impulse transmitter connected to said vehicle actuated control and to said accumulator to charge the latter by the series of impulses of equal length and regardless of the periods of individual operation of said vehicle actuated control, and means for bridging the said constant impulse transmitter to connect said vehicle actuated control to said accumulator and to charge the same by impulses extending for periods of time equal to those during which said vehicle actuated control is functioning.

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