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TRAFFIC CONTROL APPARATUS

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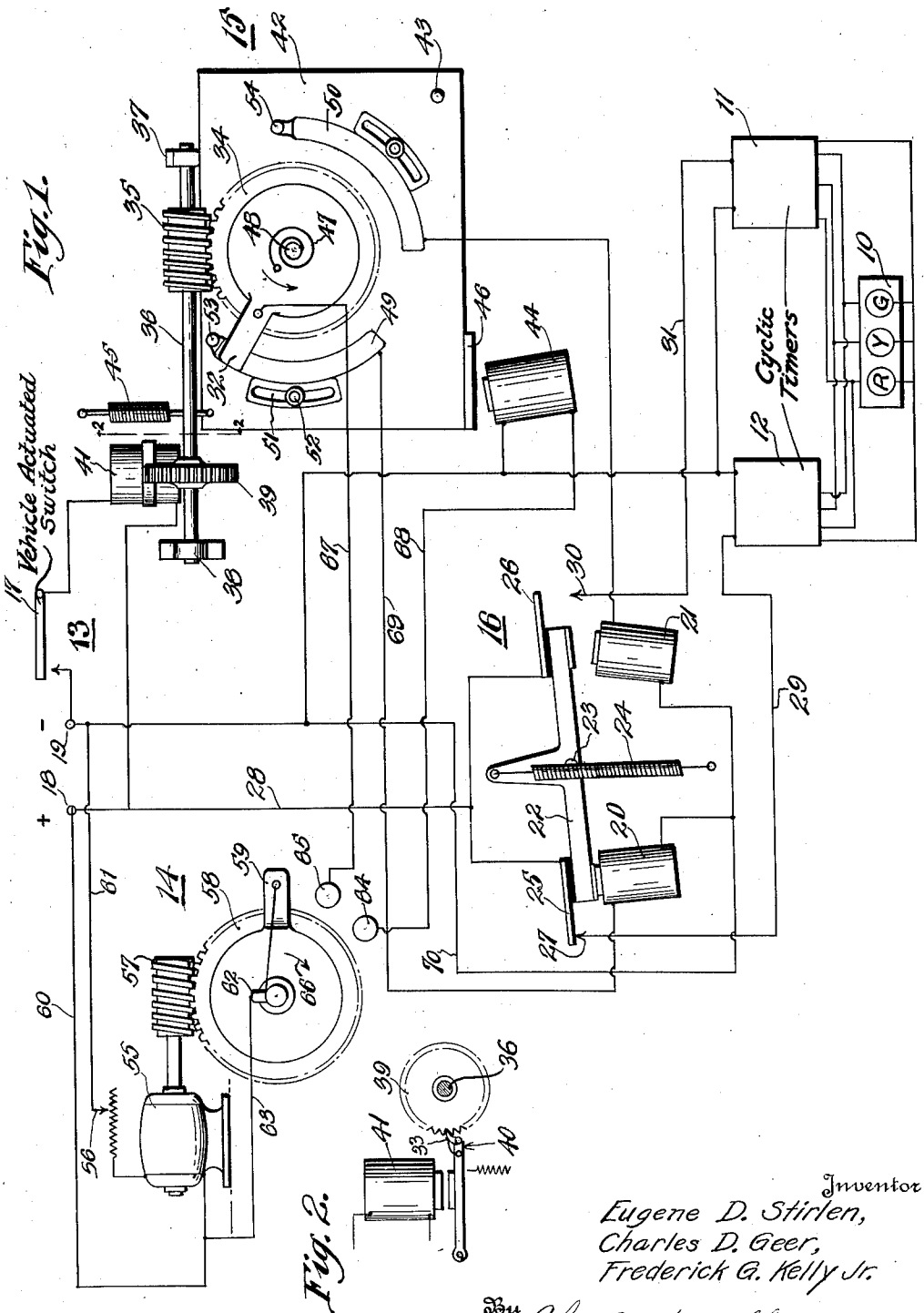

Fig. 1.

Fig. 2.

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TRAFFIC CONTROL APPARATUS

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This invention relates to automatic highway traffic signal control systems and more particularly to method and apparatus for varying the operation of the system from time to time to meet changing traffic conditions.

In the present day operation of traffic signals, the signal lights, for example, are located at street intersections and arranged to give the right-of-way successively to approaching traffic, in a fixed cycle and for predetermined intervals of time. The particular cycle selected, the timing of this cycle, and the combination of various traffic approaches to move forward simultaneously, are selected to best accommodate the average traffic conditions. Inasmuch as the traffic flow is very seldom of uniform density but is almost always either below the average point or above the average point and since neither of these conditions is satisfactorily handled by the average setting of the fixed signal control systems now employed, it is desirable to provide signal control apparatus which shall automatically adjust itself to operate the signals so as to handle traffic in a more efficient manner.

An important object of the present invention is to provide a control device for highway traffic signal systems which will change or adjust the operation of an automatic traffic signalling apparatus in accordance with the density, or volume of traffic.

Another object of this invention is to provide apparatus of the character designated which selects the system or plan of signal operation desired in response to the density or volume of traffic and maintains such plan or system until a change is required by a change of predetermined magnitude in the density, or volume of the traffic.

A further object of the invention is to provide apparatus of the character designated which is simple in operation, rugged in construction and efficient in operation to select the plan or system of signalling desired to indicate the right-of-way to vehicular traffic in response to the density thereof.

Further and more specific objects of the invention are disclosed in the following specification, reference being had to the accompanying drawing.

In the drawing:

Figure 1 is a diagrammatic view of the several mechanisms embodied in the present invention; and

Figure 2 is a view in elevation of the ratchet mechanism on line 2—2 of Figure 1.

Referring to Fig. 1 of the drawing, there is shown diagrammatically, apparatus embodying the present invention in which the numeral 10 indicates a traffic signal employing lights for indicating the usual "go", "caution" and "stop" signals. These lights are operated and controlled either by electric timing apparatus 11 or electric timing apparatus 12 which may be of any conventional type set to exhibit signals alternately to the several intersecting highways in a fixed and predetermined manner. The timer 11, for example, may be of the type which indicates the right-of-way alternately to traffic on one street for a period of forty seconds and on the intersecting street for a period of twenty seconds. Thus the signal would be operated according to one plan. In the same manner, the timer 12 may be of the type set to operate the signal system so as to indicate signals of equal duration on both streets in which case the signal would be operated according to another and different plan, it being understood that these timers alternately exhibit right-of-way signals to the intersecting streets in the manner well understood in the art.

The mechanism for changing signal-plan and so selectively operating the timers 11 and 12 to cause the plan according to timer 11 or the plan according to timer 12 to be exhibited comprises what may be termed for convenience, a vehicle operated switch or traffic-actuated controller 13, an impulse generating device 14 and impulse directing device 15 and a throw over switch or signal-plan shifter 16. For the purpose of illustration, the impulses for controlling the operation of the apparatus embodying the present invention are initiated by street devices, one of which is the controller indicated at 17 and located in the street so as to be actuated by a passing vehicle.

While we have shown that the impulse may be initiated by the closing of the street switch 17, it is obvious that any convenient mechanism may be employed to initiate the impulse and connected in the circuit so that the signal mechanism shall be operated in response to the presence of vehicles passing along the street.

The shifter, or switching device 16 is connected to a source of power supply indicated by numerals 18 and 19. This switching device consists of electro-magnets 20 and 21, and an armature 22 pivotally mounted at 23 so as to engage one or the other of the magnets. The armature is maintained in either of the extreme positions by a spring 24, the position being governed by the last magnet to be energized. The armature 22 carries at its extremities contact members 25 and 26. When the armature has been attracted by coil 20, for example, contact 25 engages a contact 27 and thus power is supplied to timer 12 by way of wire 28, contacts 25, 27 and wire 29.

If, however, the armature has last been attracted by coil 21, contacts 25, 27 are broken and contact 26 engages a contact 30 and thus power is now supplied to timing mechanism 11 by way of wire 31. From the above arrangement it will be noted that an electrical impulse received by either magnet 20 or magnet 21 causes the traffic signal 10 to operate either on timing mechanism 11 and according to one plan or timing mechanism 12 according to the other plan until another impulse is received by the other magnet to change the condition.

The impulses for controlling the operation of magnets 20 and 21 are generated periodically by the impulse generator 14. These impulses are directed to either magnet 20 or magnet 21 in accordance with the number of vehicles which have passed during a predetermined period. This period is determined by the speed of rotation of the impulse generating mechanism hereinafter described.

The impulse directing mechanism 15 includes a rotatable contact arm 32 which is moved forward progressively step by step by a pawl and ratchet mechanism 33, Fig. 2, operated in response to impulses caused by each passing vehicle. The arm 32 is mounted on a gear 34 and rotated by a worm gear 35 engaging therewith. The worm gear 35 is mounted on a shaft 36 carried in fixed bearings 37 and 38. The shaft 36 is provided with a ratchet wheel 39 adapted to be rotated by an arm 40 actuated by a magnet 41 connected in circuit with the source of supply when the switch 17 is closed. The mounting for the contact arm 32 and associated gear 34 comprises a base member 42 pivotally mounted at 43. This base is preferably of insulation material and its movement is controlled by a magnet 44 and spring 45. Attached to the base is an iron armature 46 which when attracted by magnet 44 rotates the base about its pivot 43 and thus disengages the gear 34 from the worm gear 35. When this action occurs the arm 32 is reset by action of a spring 47 as hereinafter described.

The contact arm 32 and gear 34 form a unit and this unit is loosely mounted on an axle 48 secured to the base. The gear 34 is connected to the axle by the spiral spring 47 which increases in tension as the arm and gear are rotated in a counter clockwise direction indicated by the arrow. Also mounted upon the base and adapted to be engaged by the contact arm 32 are two circuit-selecting contacts, as the segmental contact plates 49 and 50. These plates are adjustably mounted on the base as indicated by the pin and slot connections 51 and 52 so as to be adjustable one toward or from the other. This adjustment provides a greater range in the operation of the device. Associated with the segmental plates 49 and 50 are stops 53 and 54 which regulate the range of movement of the arm 32.

It is apparent that the position of arm 32 is at any time dependent upon the number of vehicles which have passed over the switch 17 since the time at which arm 32 left stop 53, the initial starting point of the arm.

The impulse generating mechanism may consist of a motor 55 provided with an adjustable speed control rheostat 56, driving gear 57 and a gear 58 associated therewith. The gear 58 carries a contact arm 59, and this arm revolves at a predetermined speed so as to give periodic impulses. For example, this arm may make one revolution every ten minutes, in which case, the condition of traffic is checked at ten minute periods. The motor 55 is driven at a desired uniform speed from the source of power indicated by wires 60 and 61. The contact arm 59 is also connected with the source of power by means of a brush contact 62 and wire 63. Associated with a movable contact arm 59 are two stationary contacts 64 and 65 spaced apart so that the arm 59 successively engages each during its clockwise rotation as indicated by the arrow 66.

The contact 65 is connected to arm 32 of the impulse directing mechanism by wire 67 and contact 64 is connected to magnet 44 by a wire 68. From this arrangement it will be noted that the movement of arm 59 effects the movement of base 42 and disengagement of the gears 34, 35, and thereby resetting arm 32 at ten minute intervals regardless of its position relative to the segments 49 and 50.

Having thus described the apparatus constructed in accordance with the present invention, the operation thereof is as follows:

Assume the mechanism is in operation just as contact arm 59 engages contact 64. Current is then supplied from the positive side of the power supply through brush 62, arm

59, contact 64, magnet 44 and thence returned to negative side of the power supply. This as previously explained causes gears 34, 35 to disengage and arm 32 is reset to a starting position against stop 53. As soon as arm 59 has left contact 64, gears 34 and 35 reengage and the passage of vehicles over switch 17 immediately energizes magnet 41 and causes the rotation of gear 35, thus sliding arm 32 forward over segment 49. The progression of the contact arm over the segment 49 is dependent upon a number of vehicles which actuate switch 17.

After a fixed period of time dependent upon the speed at which arm 59 is moved (this device thus serving as a timer), the arm reaches contact 65 and while passing over this contact, an impulse of current flows through brush 62, arm 59, contact 65, to arm 32. At this time arm 32 may be in any one of three positions, dependent upon the density or flow of traffic during the preceding period and also upon the particular position of the adjustable plate segments 49 and 50. If the arm still remains on segment 49 when the impulse is received, current flows from arm 32 through segment 49 to magnet 20 by way of wire 69 and returns to the negative side of the power supply by way of wire 70 and thus the operation of the timer is not affected.

Now assume that the increase in the number of vehicles has caused arm 32 to reach segment 50 by the end of the time period, the impulse thus generated now flows through arm 32, segment 50, thus energizing magnet 21 and returns to the negative side of the power supply. When magnet 21 is thus energized, arm 22 is moved so that contact 26 engages contact 30 thus de-energizing timing mechanism 12 and energizing timing mechanism 11, whereby the system changes over to the system of control which is better adapted to handle the change in traffic that has caused arm 32 to reach segment 50. If, however, at the end of the fixed period, which is controlled by the movement of arm 59, arm 32 stops between the contact segments 49 and 50, no circuit is completed and consequently no changes made in the system of operation. It is obvious from this description that after the critical point is determined at which the system of operation should change, the adjustment of the length of the space between segments 49 and 50 determines the extent to which the actual traffic density must differ from this critical point in order to produce a change.

It is to be understood that while the several mechanisms hereinbefore specifically described are suitable and practical embodiments of elements for carrying out the invention, nevertheless the broader aspect of the invention may be embodied in elements of quite different design from those illustrated.

It will be perceived that the density of traffic is proportional to the number of actuations of the controller 17 per unit of time, and that this density may range from zero, which would represent no traffic, to a much higher degree of density. As it is not practical always to change signal-plan in response to every small change in traffic-density, the present apparatus provides for a zone of lower-density traffic and a zone of higher-density traffic, the zone of lower-density ranging from zero actuations of the controller up to a predetermined number of actuations of the controller within a predetermined interval of time. Up to or within this critical number within the predetermined interval of time, and although the traffic-density might vary in degrees within this interval, nevertheless the condition would be that of lower-density traffic. The zone of higher-density traffic would then range upwardly from a number of actuations of the controller 17 in excess of the aforesaid critical number within the predetermined interval of time. It will be seen, therefore, that to change the signal-plan from lower-density plan to higher-density plan, the number of actuations of the controller during the predetermined interval of time must exceed the critical number, whereas selection of lower-density signal-plan from higher-density signal-plan is in response to not exceeding a predetermined number of actuations of the controller within a predetermined interval of time. When the controller 17 is actuated, the contact arm 32 moves from the stop 53, being selective of lower-density signal-plan by reason of the selecting segmental contact 49. Not unless the arm 32 reaches selecting contact 50 during said predetermined interval of time, that is, during the interval of time when the impulse arm 59 makes a complete revolution, will the lower-density-plan be changed. The critical number of actuations of the arm 32 may, therefore, be said to be that number at which, if another advance movement were imparted by the controller, it would be caused to make contact with the higher-density plan-selecting contact 50.

It will be seen, furthermore, that once either signal-plan is instituted, it will be maintained for at least a minimum predetermined period of time before subsequent change of signal-plan may be effected in response to changes in traffic-density.

The mechanism including the contact arm 32 and the rotatable contact arm 59 constitute what may be termed a traffic-density meter, this meter being not only broadly selective between the different signal-plans, but also selective of different signal-plans by different rates of action in a predetermined interval of time. The arm 32 participates as a traffic-density metering device, being a density-meter circuit-contact advanced progressively by successive actuations of the controller.

The magnet 44 and its circuit and controls cooperate to reset the density-meter to starting condition at regular intervals, the starting interval being selective of lower-density plan, and the arm 59 cooperating with contact 64 to cause return movement of the reciprocally movable contact 32 at regular intervals through the instrumentality of the spring 47. It will be seen that the shifter mechanism 16 will maintain a selected plan in operation for at least a minimum predetermined period of time, being the time required for the contact arm 59 of the impulse device 14 to make one rotation, but it will also be noted that when the traffic-density is maintained either at higher degree or at lower degree for longer than the minimum predetermined interval of time, the shifter 16 will not be actuated but on the contrary will continue to maintain the existent signal-plan in operation for another like interval of time. Thus, by the present construction, not only is provision made for changing signal-plan, but changes in traffic-density play the major part in effecting change of signal-plan, and yet the change is effected at intervals, within zones of traffic-density quite practical for accommodating the various different volumes of traffic-density which may be pertinent to the intersection at which the signal is placed.

From the foregoing, it is apparent that the apparatus involving the present invention may be employed with any standard form of signal system so as to cause a change in operation of the same in response to the volume of traffic.

While we have shown and described a preferred embodiment of apparatus for changing from one control system of operating signal lights to another, it is obvious that a similar device may be employed to control a group of signals operating under one control system.

What is claimed is:

1. A traffic control system including a signalling means, a timer for operating the same according to one cycle of timing, a second timer for operating said signalling means according to a different cycle of timing, and traffic actuated means for operatively coupling one of said timers to said signalling means.

2. A traffic control system including a signalling means, a timer for operating the same according to one cycle of timing, a second timer for operating said signalling means according to a different cycle of timing, switching means normally maintaining one of said timers connected to operate said signalling means, and said switching means being operable to connect said second timer to control the operation of said signalling means, and a vehicle actuated control governing the operation of said switching means.

3. A traffic control system including a signalling means, a timer for operating the same according to one cycle of timing, a second timer for operating said signalling means according to a different cycle of timing, switching means normally maintaining one of said timers connected to operate said signalling means, and said switching means being operable to connect said second timer to control the operation of said signalling means, means for causing said switching means to couple the second timer to operate said signal, and a vehicle actuated control to operate said last-named means.

4. A traffic control system including a signalling means, a timer for operating the same according to one cycle of timing, a second timer for operating said signalling means according to a different cycle of timing, switching means normally maintaining one of said timers connected to operate said signalling means, and said switching means being operable to connect said second timer to control the operation of said signalling means, traffic actuated means for causing said switching means to couple the second timer to operate said signal, and means tending to prevent a return of said switching means to normal position.

5. A traffic control system including signalling means for according and interrupting right of way, timing means connected to said signalling means and adapted to operate said signalling means according to any one of a plurality of differently timed signal cycles, a traffic actuated control, and means forming a part of said timing means and connected to said traffic actuated control and adapted to establish a particular signal cycle in response to actuations of said control.

6. A traffic control system including signalling means for according and interrupting right of way, means including timing mechanism connected to said signalling means and adapted to operate said signalling means so as to accord right of way according to predetermined time settings of said timing mechanism, and means connected to said timing mechanism and operating in response to change in traffic density to cause a change in said time settings.

7. A traffic control system including signalling means for according and interrupting right of way, means including timing mechanism connected to said signalling means and adapted to operate said signalling means so as to accord right of way according to predetermined time settings of said timing mechanism, a traffic actuated control, and means connected to said control and timing mechanism and functioning in response to change in traffic density, as revealed by repeated actuations of said control, to change the time settings of said timing mechanism.

8. A traffic control system including signalling means for according and interrupting

right of way, means including timing mechanism connected to said signalling means and adapted to operate said signalling means so as to accord right of way according to predetermined time settings of said timing mechanism, a traffic actuated control, and means connected to said control and timing mechanism and functioning in response to change in traffic density, as revealed by repeated actuations of said control, to change the time settings of said timing mechanism, said last mentioned means including a device to prevent change in time settings until traffic density has changed by a predetermined amount.

9. A traffic control system including signalling means for according and interrupting right of way, means including timing mechanism connected to said signalling means and adapted to operate said signalling means so as to accord right of way according to predetermined time settings of said timing mechanism, a traffic actuated control, and means connected to said control and timing mechanism and functioning in response to change in traffic density, as revealed by repeated actuations of said control, to change the time settings of said timing mechanism, said last mentioned means including a device to prevent change in time settings, as established by previous traffic density, until traffic density has changed by a predetermined amount from said previous traffic density.

10. A traffic control system including signalling means for according and interrupting right of way, timing means for operating said signals according to any one of a plurality of different signal cycles and means operating in response to change in traffic density to cause said timing means to establish a signal cycle different from the one previously maintained.

11. A traffic control system including signalling means for according and interrupting right of way, timing means for operating said signals according to any one of a plurality of differently timed cycles for different traffic densities, a traffic actuated control, and means connected to said control and timing means and acting in response to repeated actuations of said control to automatically select and maintain a particular cycle corresponding to the traffic density then existing.

In testimony whereof we affix our signatures.

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