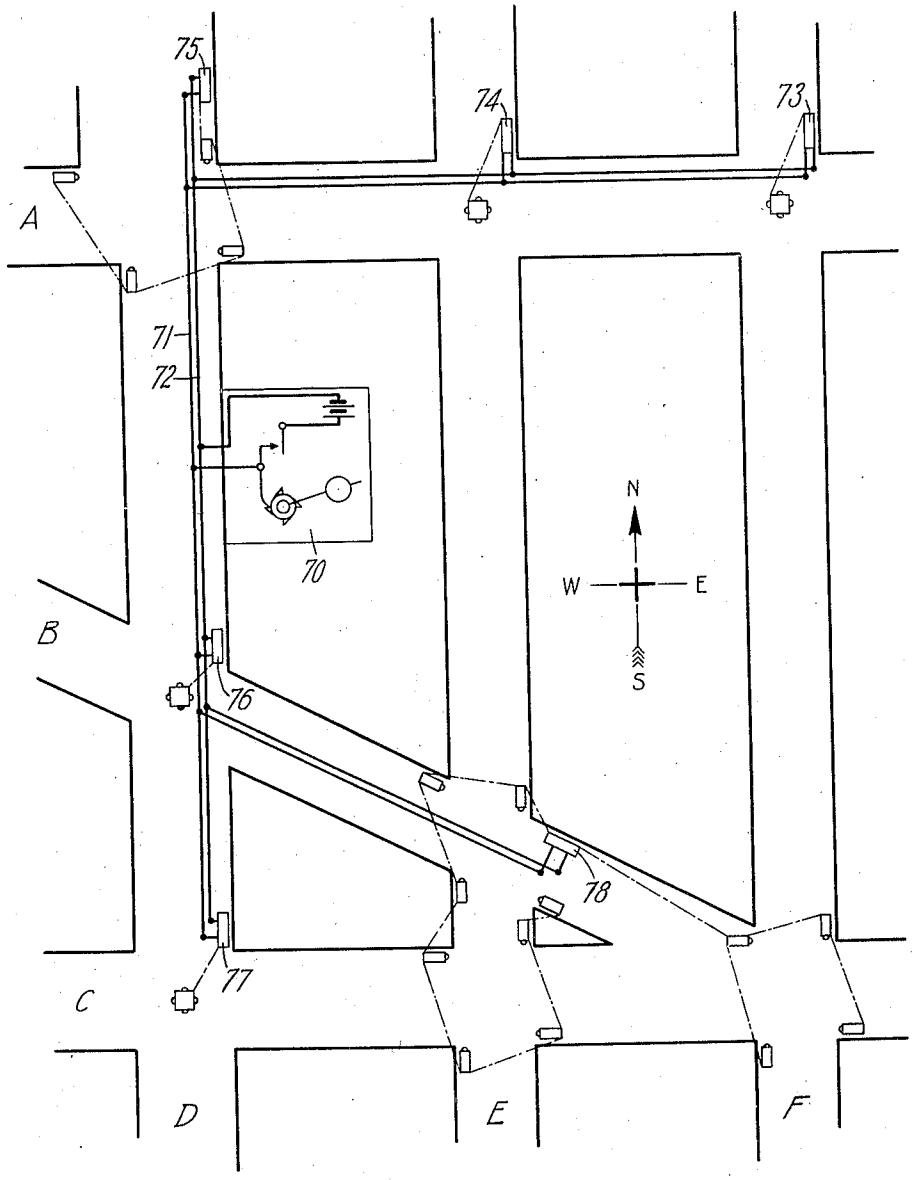
Oct. 24, 1933. J. B. RADFORD 1,931,851

TRAFFIC CONTROL SYSTEM

Filed June 12, 1928 3 Sheets-Sheet 1

FIG. 1



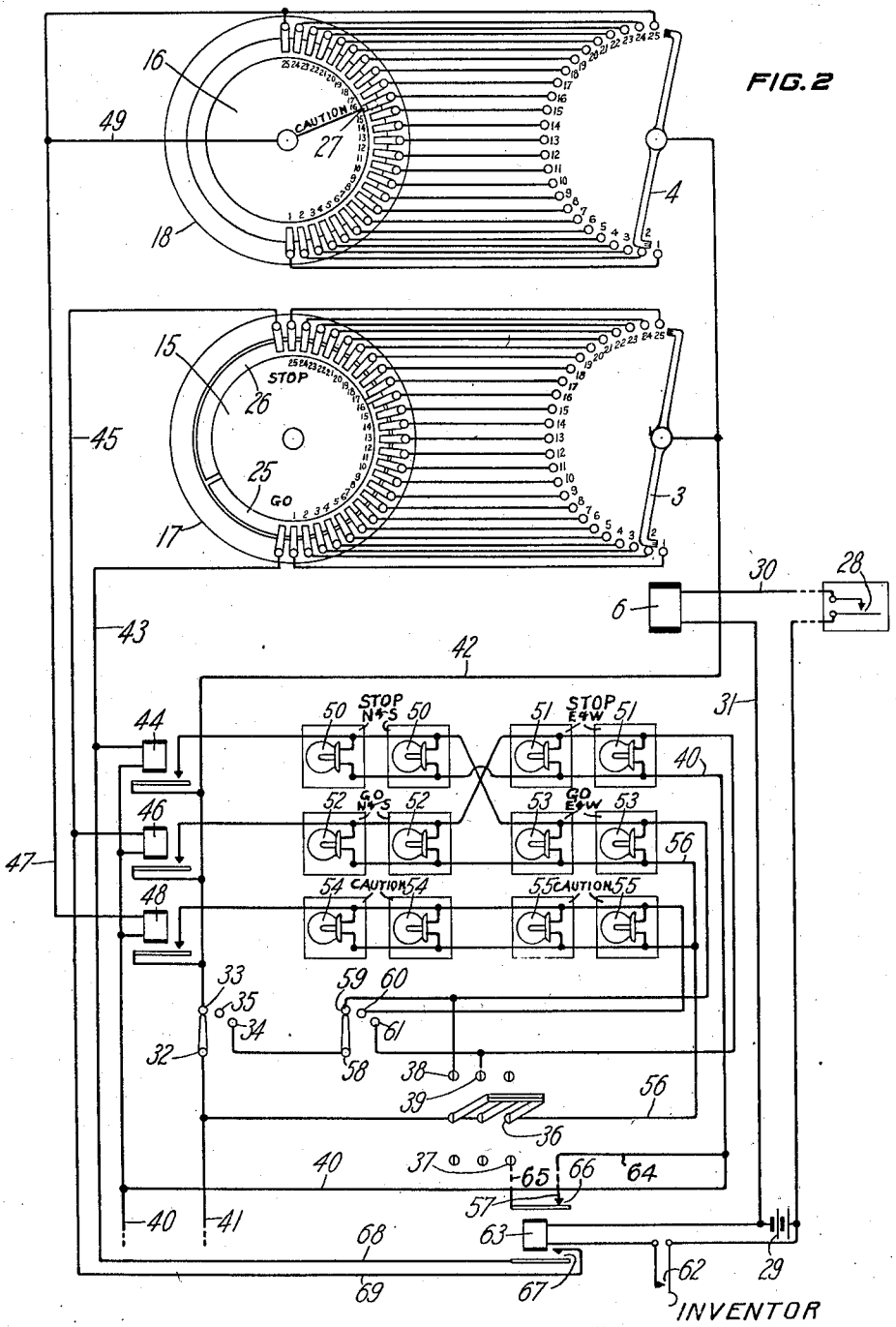
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TRAFFIC CONTROL SYSTEM

Filed June 12, 1928 3 Sheets-Sheet 2

FIG. 2



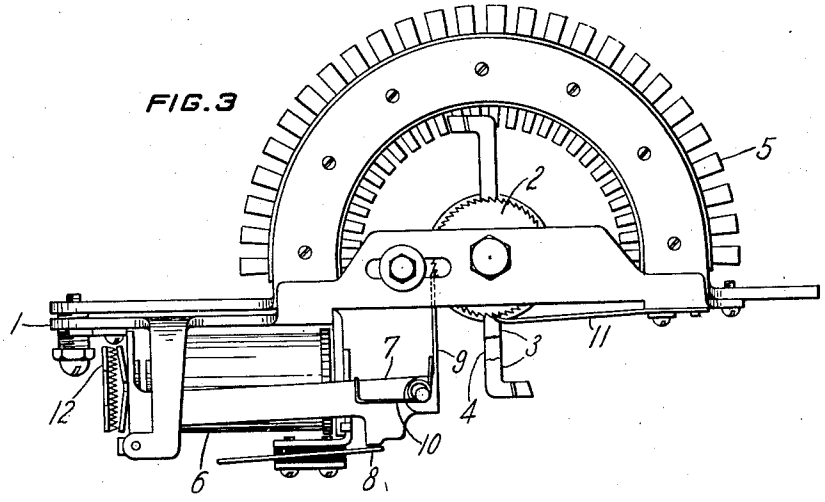
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TRAFFIC CONTROL SYSTEM

Filed June 12, 1928 3 Sheets-Sheet 3

FIG. 3



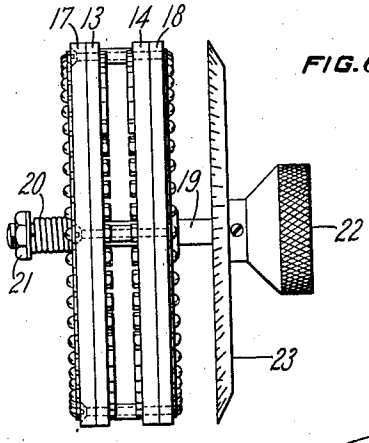


FIG. 6.

FIG. 4.

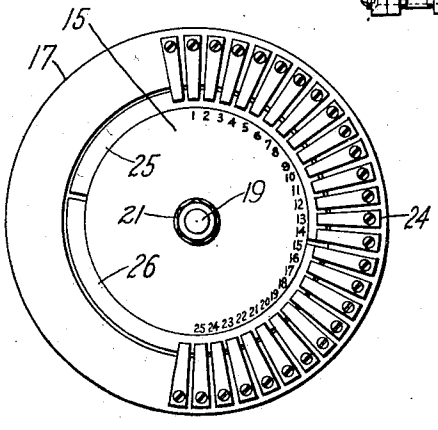
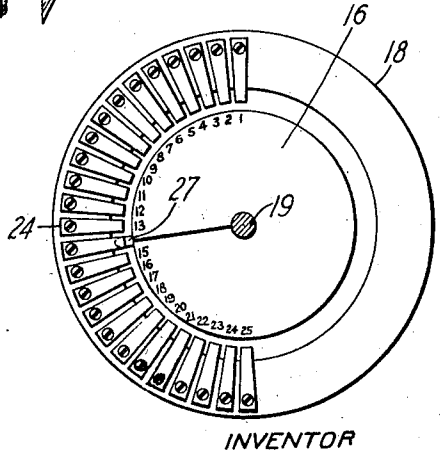


FIG. 5.



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UNITED STATES PATENT OFFICE

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TRAFFIC CONTROL SYSTEM

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Application June 12, 1928, Serial No. 284,782, and in Canada August 12, 1927

1 Claim. (Cl. 177—338)

This invention relates to signaling systems for the control of street traffic.

Its object is to provide a system for the directing of street traffic which utilizes a single pair of wires to control any number of signal lights, the time interval of each signal light being individually adjustable.

In accordance with this invention a selector switch is provided for each signal light. This selector switch regulates the time interval between light changes and is individually adjustable to suit the traffic conditions at the point where the signal is located. Any number of selector switches may be controlled from a central point by the same controlling apparatus.

The increasing complexity of the problems involved in the orderly control of street traffic has led to the extensive use of electric signals, the present trend being to use visible signals consisting of three colored lights. The preferred traffic cycle for a traffic lane is to show a green "Go" light for a convenient time, extinguish it, and show an amber "Caution" light momentarily, extinguish it and show a red "Stop" light for a convenient time, extinguish it and show an amber "Caution" light momentarily, extinguish it and repeat the cycle. This cycle may be condensed to two operations by showing the "Caution" light momentarily with the "Go" signal toward the end of the "Go" operation and extinguishing both together, the "Caution" remaining off until near the end of the "Stop" operation when the "Caution" light is shown momentarily with the "Stop" signal and both extinguished together.

At the present time, the so-called "synchronous" system is generally used, in which the signal lamps are lighted through switches, usually of the mercury type, operated by a set of cams rotated by a small induction motor. The motor consists of a copper disc revolving between iron pole pieces excited by a winding connected directly to a 110 volt alternating current circuit; the speed of the motor is regulated by eddy currents induced in the revolving disc by the poles of a permanent magnet. The time during which a signal is lighted is varied by altering the relative positions of the cams, while the time required for a complete cycle of operations is regulated by the speed of the motor. If a number of signals are to be controlled, they are combined into groups, each group being controlled by a relay which is operated by the cams on the motor. This system is objectionable because all the signals in a group operate simultaneously, thus a busy intersection laden with street car and bus traffic may have to operate on the same traffic cycle as a quiet intersection. If separate motors be installed to avoid this trouble, it is difficult to prevent them from getting out of synchronism with a consequent derangement and crowding of the traffic. The trouble could be avoided by the use of synchronous motors, but the cost would be materially higher.

In the so-called "progressive" system, a modification of the synchronous system, the colors are reversed to form blocks of such length that traffic entering one end of the block on a green signal will just reach the other end as the red signal turns to green, and thus the traffic proceeds uninterruptedly. This system assumes that the time required to traverse a block is invariable, and that a traffic cycle may be used in which "North and South" bound traffic and "East and West" bound traffic pass an intersection in equal periods of time.

To avoid the difficulties inherent in the synchronous and progressive systems, the "coordinated" system was developed, in which the period of the traffic cycle is the same throughout an area, but is subdivided in different proportions to suit the requirements of certain intersections. For example, an area may have a period of 90 seconds, the intersections with light traffic having say 50 seconds "Go" and 40 seconds "Stop", while an intersection carrying heavy street car traffic may require 60 seconds "Go" and 30 seconds "Stop", thus lessening the congestion at the busy intersection, without materially affecting the traffic on the cross streets. To the applicant's knowledge, up to the time of the filing of this application, this system has been installed in only one district of a large city on this continent, and, as the system used requires seven wires from each separate intersection to traffic headquarters, it will be seen that, if a large number of intersections are to be controlled, the system will become unwieldy and the expense enormous.

The signaling system described herein employs only one pair of wires from traffic headquarters for operating any number of intersections having the same period for a traffic cycle but different timing intervals.

Other features and advantages of the invention will appear from the following description and from the claim appended thereto, reference being made to the accompanying drawings in which:

Fig. 1 is a schematic diagram of a traffic signal system.

Fig. 2 is a circuit diagram of a controller, regu-

lating switch, traffic signals and associated relays, with manual and automatic control, local "Stop" switch and remotely controlled "Stop" switch.

Fig. 3 is a rotary controller.

Fig. 4 is a view of the lower contacts of a regulating switch.

Fig. 5 is a view of the upper contacts of the same switch.

Fig. 6 is a side view of the regulating switch.

Similar characters of reference indicate corresponding parts throughout the various views.

The rotary controller shown in Fig. 3 is similar to the controller disclosed in United States Patent 1,472,465 issued October 30, 1923 to O. F. Forsberg and R. M. De Vignier.

On the frame 1, is rotatably mounted a spindle to which is rigidly secured a ratchet wheel 2, and two sets of similar wiper arms 3 and 4, arranged to pass over the two banks of contacts 5, each bank consisting of say 25 contacts. In this specific switch, the wiper arms are so arranged that when one end of the wiper arm is rotated off the last bank contact, the other end comes into engagement with the first bank contact. The wiper arms are also so arranged that when rotated, the contact tips make engagement with a second contact before they are out of engagement with the one from which they are passing, thus holding the circuit closed during the movement.

When the magnet 6 is energized, it attracts the armature 7 forcing the free end of the armature downward against the tension of the spring 8, advancing the pawl 9, which is caused to engage another tooth on the ratchet wheel 2 by the spring 10. The ratchet wheel 2 is held stationary by the detent 11. When the magnet 6 is deenergized, the spring 8 forces the free end of the armature 7 upward until the end of the armature 7 comes into contact with the back stop 12. This movement of the free end of the armature 7 carries the pawl 9 upward, rotating the ratchet wheel 2, and advancing the wipers 3 and 4 into engagement with the next set of contacts. This operation is repeated each time the magnet 6 is energized and deenergized.

For further details of the construction of this switch, reference may be had to the above mentioned patent.

The regulating switch shown in Figs. 4, 5, and 6 is similar to the multiple switch disclosed in United States Patent 1,422,549, issued July 11, 1922 to Augustus J. Eaves.

Referring now to Figs. 4, 5, and 6 two circular flat plates 13 and 14 of suitable insulating material are rigidly fixed together, and support two annular members 17 and 18 of suitable insulating material. Mounted within the annular members 17 and 18 are two rotatable disc shaped members, 15 and 16; the disc shaped member 16 being firmly attached to the shaft 19, and the disc shaped member 15 being slidably keyed to the shaft 19, the discs 15 and 16 being held to the plates 13 and 14 by the pressure of the spring 20 due to the nut 21. The shaft 19 and discs 15 and 16 may be rotated by the knob 22, the degree of rotation being indicated on the dial 23.

Mounted on the annular members 17 and 18 are a plurality of spring contacts 24, the free ends bearing on the rotatable discs 15 and 16 and the fixed ends having suitable means for soldering conductors thereto. Two commutator segments 25 and 26, of suitable conducting material are securely positioned in the disc 15, the upper surface of the commutator segments being flush with the surface of the disc, and each commutator segment spanning slightly less than 180° of arc. A commutator segment 27 of suitable conducting material is similarly positioned on the disc 16, spanning an arc equal to that spanned by one contact, and being placed directly above the end of segment 25 adjacent to segment 26.

Referring now to Fig. 2, in which is shown a circuit diagram of the traffic control system, contact 28 is made and broken at regular intervals by a master controller (not shown) of any suitable type.

When the master controller closes the contact 28, current will flow from battery 29, through contact 28, and wire 30, winding of magnet 6, wire 30 to battery 29, energizing the magnet, and attracting the armature. When the master controller opens the contact 28, the magnet 6 is deenergized, the armature is forced back and the wipers 3 and 4 advance one contact. This cycle of actions will be repeated at regular intervals under the control of the master controller, stepping the wipers from contact to contact around the bank. When one end of the wiper steps off the last contact, the other end of the wiper steps on to the first contact, so that the action is continuous.

The contact bank of wiper 3 is wired to the contacts mounted on the annulus 17 of the control switch, Fig. 4, and the contact bank of wiper 4 is wired to the contacts mounted on the annulus 18 of the same control switch.

Under normal conditions, the switch 32 is on contact 33, and switch 36 on contact 37. When the wiper 3 is on the first contact of the bank, a circuit is formed from the commercial supply circuit wire 41, switch 32, contact 33, wire 42, wiper 3, bank contact #1 and wire to switch contact #1, commutator segment 25, wire 43, relay 44, wire 40 to the commercial supply circuit. Relay 44, which may be of any suitable type, operates closing a circuit from wire 41, switch 32, contact 33, contacts of relay 44 to signals 50 and wire 40, also to signals 53, wire 56, switch 36, contact 37, wire 57 and wire 40, lighting signals 50 and 53. The signals 50 may be, for example, the "Stop" signals for North and South traffic and the signals 53 the "Go" signals for East and West traffic. Relay 44 will remain operated and signals 50 and 53 will remain lighted while the wiper 3 steps from bank contact #1 to bank contact #16, when the commutator segment 25 is in the position shown in Fig. 5, and, if the master controller operates once every 4 seconds, these signals will be operated for $16 \times 4 = 64$ seconds.

When wiper 4 steps on to bank contact #16, a circuit is formed from wire 41, switch 32, contact 33, wire 42, wiper 4, bank contact #16 and wire to switch contact #16 commutator segment 27, wire 47, relay 48, to wire 40. Relay 48 will operate and close a path from wire 41, switch 32, contact 33, contacts of relay 48, signals 54, and 55, wire 56, switch 36, contact 37, wire 57 to wire 40, lighting the signals 54 and 55. Signals 54 may be, for example, "Caution" signals for North and South traffic and signals 55, "Caution" signals for East and West traffic.

When wiper 4 steps off bank contact #16, relay 48 releases, and signals 54 and 55 are extinguished. Similarly, when wiper 3 steps off bank contact #16, relay 44 releases, and signals 50 and 53 are extinguished.

When wiper 3 steps on to bank contact #17, a circuit is formed from wire 41, switch 32, contact 33, wire 42, wiper 3, bank contact #17 and wiring to switch contact #17, commutator segment

26, wire 45, relay 46 to wire 40, operating relay 46. The operation of relay 46, closes a path from wire 41, switch 32, contact 33, contacts of relay 46 to signals 51 and wire 40, also to signals 52, wire 56, switch 36, contact 37, wire 57 to wire 40, lighting signals 51 and 52. The signals 52 may be, for example, the "Go" signals for North and South traffic and signals 51 the "Stop" signals for East and West traffic. Relay 46 will remain operated and signals 51 and 52 will remain lighted while the wiper 3 steps from bank contact #17 to bank contact #25, and, if the master controller operates once every 4 seconds, these signals will be operated for $9 \times 4 = 36$ seconds.

When wiper 4 steps on to bank contact #25, a circuit is formed from wire 41, switch 32, contact 33, wire 42, wiper 4, bank contact #25, and wiring to switch terminal #25, connector 49, wire 47, relay 48 to wire 40, operating relay 48 and lighting the "Caution" signals through the circuit previously traced.

Thus one rotation of the rotary controller has resulted in traffic passing North and South for 64 seconds, the last 4 of which showed a "Caution" light, then the traffic passes East and West for 36 seconds, the last 4 of which also showed a "Caution" signal, and this sequence of events will continue as long as the rotary controller is stepped around.

It is obvious, that if the regulating switch be rotated until the end of commutator segment 25 is under a switch contact other than #16, that a different subdivision of the total time will result. For example, if the end of commutator segment 25 be under switch contact #14, traffic will pass from North to South for 56 seconds, and from East to West for 44 seconds. Furthermore, it is not essential that the regulating switches of different rotary controllers on the same circuit have the same setting, thus one intersection may have say 64 seconds "Go" and 36 seconds "Stop" for North and South traffic, and another intersection on the same circuit may have 56 seconds "Go" and 44 seconds "Stop", or other values desired. Furthermore, by varying the number of contacts used on the bank of the rotary controller, and regulating switch, and by varying the timing of the master controller, the timing intervals may be varied over wide limits. Also, on intersections working on a fixed traffic cycle, the regulating switch may take the form of two conductors, either movable or fixed, arranged to short circuit the bank of the rotary controller in two groups.

If abnormal conditions arise at an intersection which render it necessary for a traffic officer to stop all traffic, switch 36 may be operated to close contacts 38 and 39. The opening of contact 37 cuts off signals 52, 53, 54 and 55, while the closing of contacts 38 and 39 will light signals 50 and 51, stopping all traffic.

The traffic officer may desire to manually take over the operation of the signals till the trouble has been cleared. By operating switch 32 to contact 34, and restoring switch 36 to contact 37, the traffic officer can control the signals manually by means of switch 58. With switch 58 on contact 59, a circuit may be traced from wire 41, switch 32, contact and wire 34, contact and wire 59, signal 50 to wire 40, and signal 53, wire 56 to wire 40, lighting the signals and allowing traffic to pass say from North to South. When switch 58 is moved to contact 60, signals 50 and 53 are extinguished and "Caution" signals 54 and 55 are lighted. When the switch 58 is moved to contact 61, the signals 51 and 52 are lighted, allowing traffic to pass say from East to West. Thus the traffic officer can operate the signals as long as required. As soon as switch 32 is restored to contact 33, the signals operate under control of the master controller and in synchronism with the other signals in the area.

In many cases it is necessary for the Fire Department to have means for stopping all traffic along a predetermined route from the fire station, to permit the fire fighting apparatus to proceed at high speed from the vicinity of the station. A series of intersections are selected to form the desired route, and a relay 63, of any suitable type well known in the art is incorporated in the control circuit of the intersections selected. The wire 57 is opened at points 64 and 65 and connected to the break contacts 66 of the relay 63, and relays 44 and 46 are connected through wires 68 and 69 to the make contacts 67 of the relay 63, as shown in Fig. 2. The relay may be operated by any suitable source of electric power, Fig. 2 showing a connection to the control battery 29 through a switch 62, located in the fire station. When the switch 62 is closed relay 63 operates, opening contacts 66 and cutting off the return circuit of signals 52, 53, 54 and 55, which may be the "Go" and "Caution" signals, and closing contacts 67, placing a short circuit on wires 43 and 45.

The operation of relay 63 has not interfered with the regular operation of the control circuit 28, which continues to step the wipers 3 and 4 round the contact bank. With the control segments 25 and 26 in the position shown in Fig. 2 when wiper 3 is stepping over bank contacts #1 to #16 a circuit is made from wire 41, switch 32, contact 33, wire 42, wiper 3, bank contacts #1 to #16 and wiring to switch contacts, segment 25 wire 43, to relay 44, and also wire 68 relay contacts 67 and wire 69 to relay 46, operating relays 44 and 46 and lighting signals 50 and 51, which may be the "Stop" signals for all traffic. When wiper 3 is stepping over bank contacts #17 to #25, a similar circuit may be traced to segment 26 and wire 45 to also operate signals 50 and 51. Thus all traffic will be stopped until switch 62 is opened when the signals will again operate under the control of the master controller.

To illustrate the flexibility of this invention, in Fig. 1 is shown a small area of a traffic control system. A central control station 70 is indicated, with a master controller in the form of an impulse transmitter sending electric impulses at regular intervals over the pair of conductors 71 and 72, to a plurality of controllers 73, 74, 75, 76, 77 and 78 located at the various traffic intersections. These traffic intersections will normally be street intersections, but in some cases, as shown with controller 78, the traffic intersections may combine more than one street intersection. Controllers 73, 74, 76 and 77 are shown each controlling a four way signal stand preferably located in the center of the street intersection, the signals aligned to direct their light down the centre of the four intersecting streets.

As indicated at controller 75, at some intersections, it may be more convenient to use a signal stand for each lane of traffic, these signal stands, of course, consisting each of a "Go" "Stop" and "Caution" signal and cooperating under one controller; or even to have a number of signal stands under one controller as shown with controller 78.

Assume that avenue A has a heavy stream of traffic, which in the area shown, is largely through

traffic, and that the other avenues have a normal density of traffic. Assuming a traffic cycle of say 100 seconds, we can allow traffic to pass on avenue A for say 60 seconds, and to cross avenue A for 40 seconds. The other intersections could be on a traffic cycle of say 50 seconds pass and 50 seconds stop. Thus on avenue D for example traffic will move ahead and across avenue A for 40 seconds, then for 10 seconds traffic will continue on avenue D but will be stored in the block between avenues A and B, while traffic moves on avenue A, then for 50 seconds all traffic stops on avenue D and moves on the cross avenues A, B and C. In this way, the normal traffic on avenues B, C and D is handled in an orderly fashion, while the heavy traffic on avenue A is not unduly held up by the lighter traffic on avenue D.

While this invention has been described in connection with specific circuit arrangements, it will be obvious to those skilled in the art that the invention is not limited to the details shown and described, but that suitable modification to adapt it to different circumstances may be made without departing from the scope of the appended claims.

What is claimed is:

A traffic control system comprising a signal station, an impulse transmitter for sending out impulses at predetermined intervals, a pair of conductors connecting said impulse transmitter to said signal station, magnetically operated stepping switches located at said signal station and operated by electrical impulses transmitted over said pair of conductors from said impulse transmitter, manually adjustable rotary switches having a series of contacts thereon coresponding to the contacts on said stepping switch, conductors connecting the contacts on said stepping switch to corresponding contacts on said rotary switch, a plurality of light signals, relays controlling the same, an extra pair of contacts on said rotary switch, means connecting each one of said pair of extra contacts to one of said relays, a pair of commutator segments insulated from each other mounted on said rotary switch and in engagement with said contacts, and means connected to said segments for rotating said segments to vary the number of contacts brought into engagement with each of said segments.

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