Oct. 14, 1941. P. G. HUGHES ET AL 2,258,764

TRAFFIC SIGNAL

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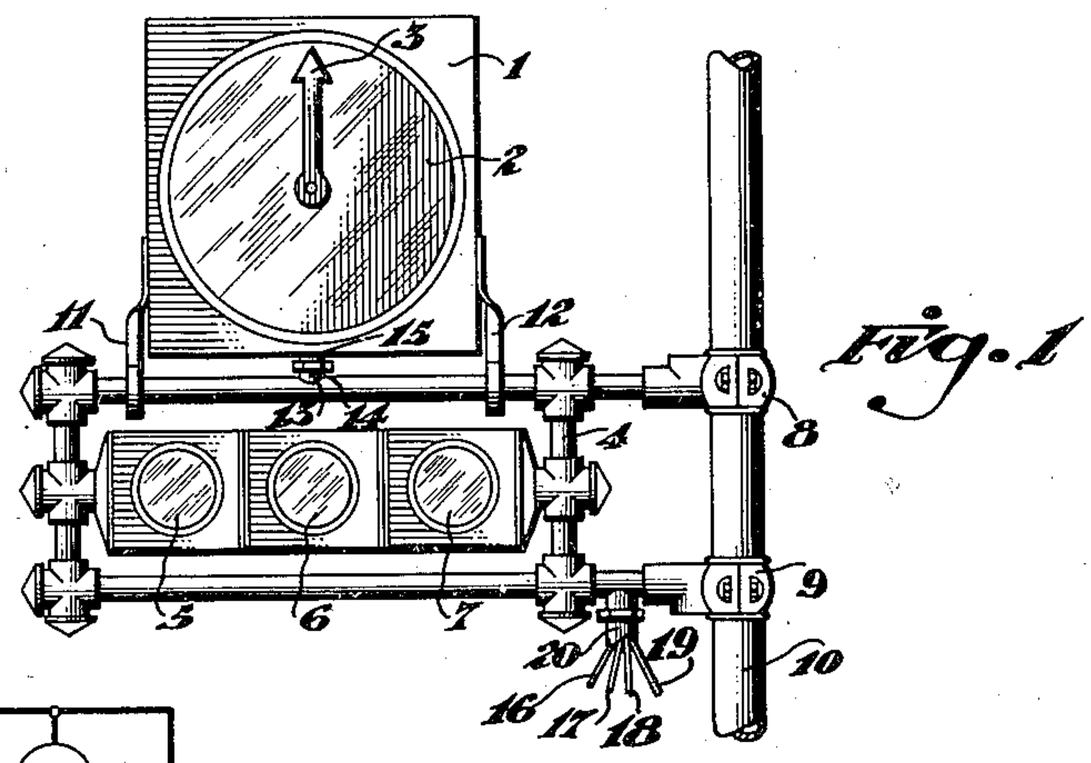

Fig. 1

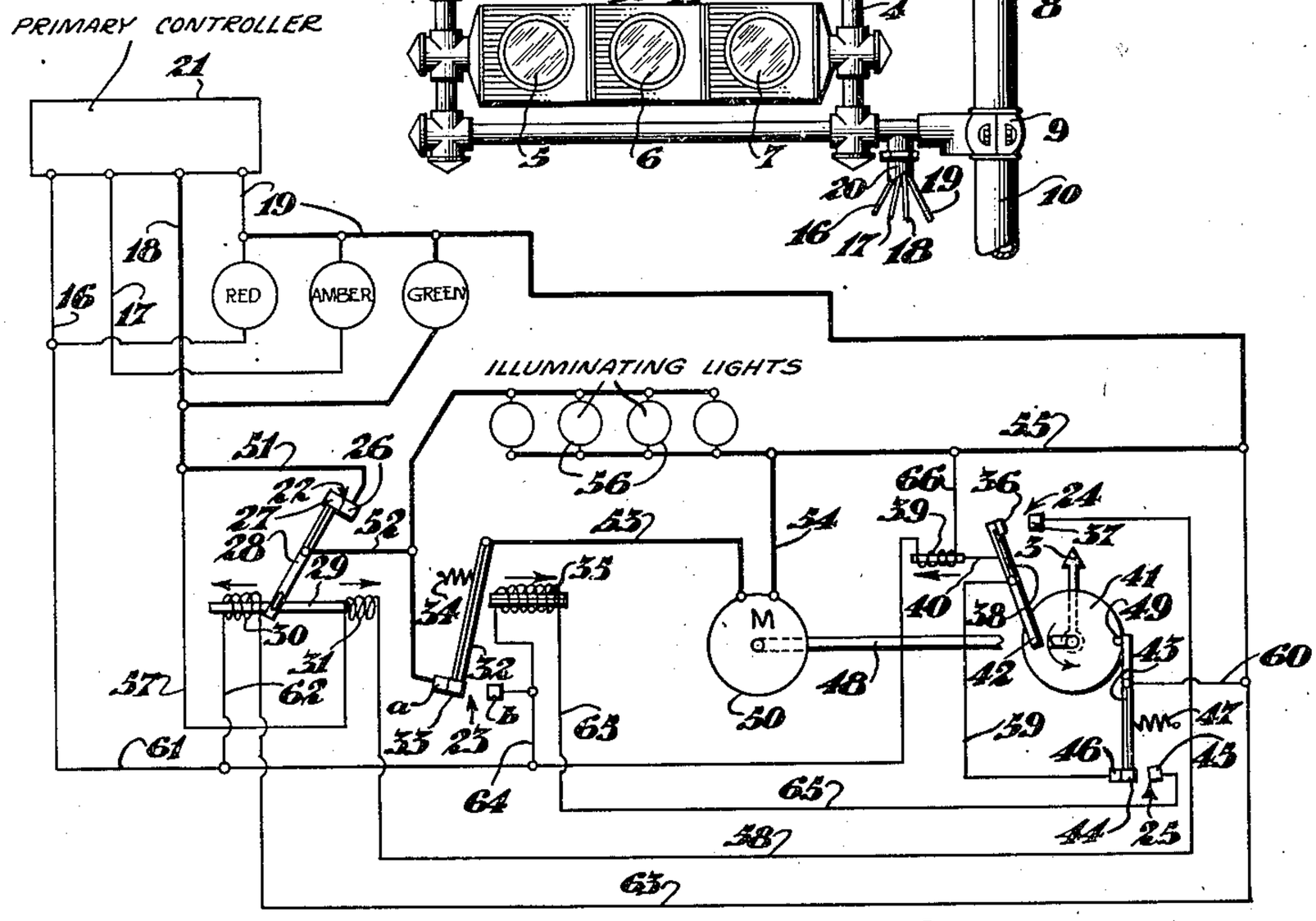

Fig. 2

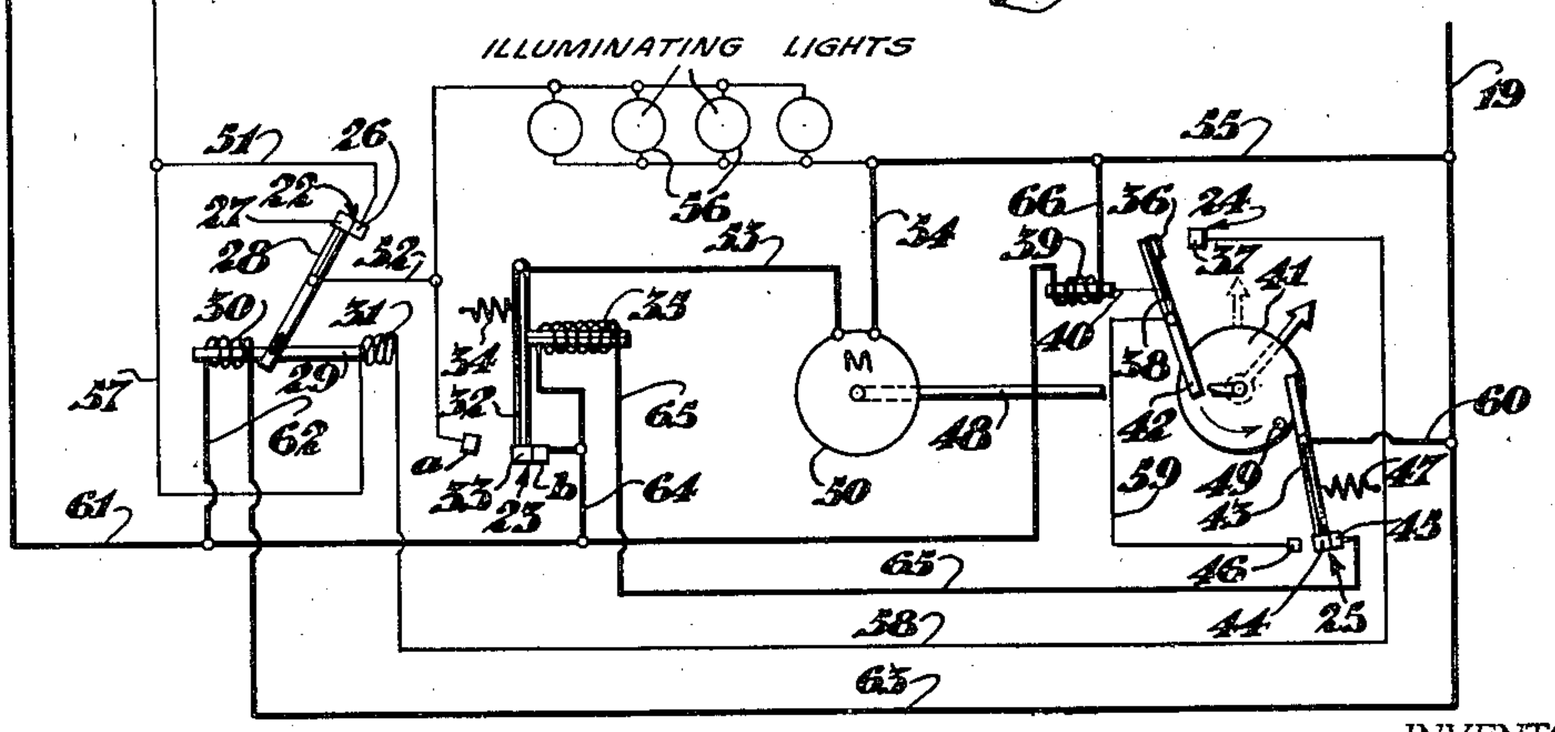

Fig. 3

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TRAFFIC SIGNAL

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5 Claims. (Cl. 177—337)

This invention relates to traffic signals of the type embodying green, yellow or amber, and red lights for controlling the flow of traffic through a street intersection. The invention is directed particularly to an improved signal for forecasting signal changes.

The traffic signals which are in use at the present time change abruptly from green to red or amber, and vice versa. The operator of a vehicle approaching such a signal light has no indication of the remaining interval of time before the signal light will change. If the light be red as the vehicle approaches, there is relatively little hazard involved since a stop warning is given. However, if the signal be green as the vehicle approaches, and then changes to red abruptly, there is danger that the vehicle will collide with others proceeding in accordance with the signal change. The use of amber lights, intermediate to the red and green signal lights, is helpful in protecting pedestrians, but such warning intervals have not been completely satisfactory for controlling automobile traffic.

The primary object of the present invention has been to provide an indicator for announcing or indicating forthcoming signal changes. In accordance with the invention, the indicator operates in conjunction with the traffic lights and may designate either the elapsed period of time since the last signal change, or the interval of time remaining before the next signal change.

Most traffic signal apparatus in use at the present time is of a relatively standard type, embodying the signal lights themselves and an electric controller for energizing them at predetermined periods. The signal lights are installed either at the street corners, or, in some instances, a single four-way light unit is suspended at the center of the intersection. Four wires usually are strung from a signal controller, which may be located at a remote point, to the signal units; three of these wires usually are individual to the three respective lights, red, amber, and green, and the fourth wire common to all. The systems usually are operated upon 110 volt potential. The object of the present invention has been to provide an indicator unit operable in conjunction with such a signal light system, deriving its current from the wires leading to the signals from the control box and deriving its primary control from the primary signal controller.

A further object of the invention has been to provide means of maintaining synchronism between the operation of the indicator and the operation of the signal light unit, either when the light unit be controlled automatically from the primary control, or manually, as by a traffic officer.

The preferred embodiment of the invention comprises a cabinet which is arranged for mounting adjacent or upon the signal light itself; if there be four signal lights, an indicator is provided at each one, and if there be a single signal light at the center of the intersection, the indicator unit has four dials, each visible from a given direction. Each indicator is comprised of an illuminated dial over which a movable pointer is exposed. An electric drive is provided for moving the pointer about the face of the dial, and the speed of the drive is synchronized with the primary signal controller timing, so that the pointer is driven through one cycle of movement during the interval in which the green light is energized.

The electric drive means for moving the dial indicator is in circuit connection with the green signal light, and switch means responsive to the movement of the pointer is employed for breaking the circuit to the electric drive when the pointer has completed one cycle of indication.

The apparatus also includes interlocking switch means for maintaining the synchronism of the indicator with the green light. This feature is considered to be of importance for two reasons: It is well known that a signal device which is operated improperly places a much greater hazard upon the traffic than the employment of none at all; and, on the other hand, it is frequently necessary for a traffic officer to operate the primary controller by hand, and such manual operation may, and very likely will, upset the synchronism of the indicator with the signalling cycles when the system is returned to automatic operation if the synchronism be dependent entirely upon energization of the green light circuit. In the present apparatus, therefore, the interlocking switch means is arranged for energizing the electric drive unit from the red light circuit in those instances when or if the green light circuit is deenergized before the pointer has completed a cycle of indication.

The drawing illustrates a preferred embodiment of the invention which is suited for installation directly upon the signal light of a corner type light in common use at the present time.

Figure 1 is a face view of the assembly of the indicator and the signal lights.

Figure 2 is a diagrammatic view of the circuit of the indicator, looking toward the back of the pointer dial. The heavier lines represent the

leads being energized, while the lighter lines represent the leads which are idle. As shown, the circuit is being energized by the green light circuit of the primary traffic controller just at the start of its cycle.

Figure 3 is a diagrammatic view of the circuit of the indicator as it appears at the beginning of a red light cycle, just after an interrupted green light cycle, i. e. one in which the green light circuit was broken before the hand of the indicator could complete its cycle.

The indicator unit is comprised of a housing 1, having a dial face 2 of glass or suitable transparent or translucent material over which a pointer 3 is disposed for rotation. The signal light itself upon which this unit is mounted is comprised of a framework 4, of pipe or conduit, for example; and the signal light unit housing the stop, caution, and go signals, 5, 6, and 7 is carried within the framework. The framework is carried upon brackets 8 and 9; these usually are mounted upon a vertical standard or post 10, as shown. If desired, the signal lights themselves may be incorporated in the casing with the forecasting indicator. Likewise, the circuit switching means for the forecasting signal may be included in the primary controller housing, if necessary to suit particular installation conditions.

The housing 1 carries a pair of brackets 11 and 12, one for each side, and these brackets are fastened upon the framework 4, for assembly of the indicator with the traffic signal unit. The upper conduit of the framework upon which the indicator is mounted is provided with an outlet 13, for connection through a union 14 with an outlet 15 in the housing; and the leads to the indicator from the common and individual leads to the signal lights are taken through this connection. The lead wires 16, 17, 18, and 19 from the primary traffic controller enter the unit at the outlet 20.

The mechanical details for the construction of the housing, and such modifications as may be necessary to adapt the unit for use in conjunction with traffic signal lights other than the type shown, readily will be understood by those skilled in the art and, for that reason, are not here described in detail.

As illustrated in Figure 2, leads 16, 17, 18, and 19 are taken from the primary controller, which is indicated diagrammatically at 21; the lead 16 being individual to the red light, the lead 17 being individual to the yellow or amber light, the lead 18 being individual to the green light, and the lead 19 being common to all three lights. The amber light has no connection into the indicator circuit, and therefore, the circuit is dead during the amber light interval.

The electrical circuit includes switches 22, 23, 24, and 25. Switch 22 consists of a stationary contact 26 and a movable contact 27. The movable contact is carried on one end of a pivoted switch arm 28. The other end of the pivot arm is connected to an armature 29. The armature is actuated by either one or the other of a pair of solenoids 30 and 31. Solenoids 30, when energized, pulls the armature toward it and so serves to move the pivoted switch arm 28 and its contact 27 into a closed position with respect to contact 26. Solenoid 31, when energized, acts upon the armature to open the switch 22.

As shown in the diagram, the switch arm 28 may be connected to the armature by a pin carried on the armature acting in a slot in the arm, or they may be connected through a toggle arrangement or other means, to keep the parts from binding as the pivot swings through its arc.

Switch 23 is composed of a movable arm 32 carrying a contact 33 for engagement with either one of two contacts *a* or *b*, both of which are stationary. Normally, a spring 34 holds the switch arm 32 and its contact 33 in connection with contact *a*, but when a solenoid 35 is energized, the spring tension is overcome by the solenoid, and the contact 33 is brought into connection with the *b* contact.

Switch 24 consists of a movable contact 36 and a stationary contact 37. The movable contact 36 is carried on the pivoted switch arm 38. Switch 24 is opened when a solenoid 39 is energized, its armature 40 being connected to the pivoted switch arm 38. Switch 24 is closed by a cam, indicated generally at 41, acting upon the end 42 of its switch arm on the side of the pivot point opposite the contact. This closing action is described at a later point in the specification.

Switch 25 is comprised of a movable switch arm 43, carrying a contact 44 which swings intermediate two contacts 45 or 46, both stationary. Normally, the switch arm holds contact 44 in engagement with contact 45 by action of spring 47; however, the end of the switch arm is extended for actuation of it by cam means 41 for closure of contact 44 with contact 46.

The cam 41 is comprised of a disc or other suitable means keyed to the shaft 48 which carries the pointer 3, so that the two, disc and pointer, revolve together. The cam disc carries a pin 49, which acts upon the end 42 of the switch arm 38 to swing it outwardly away from the center of the disc, at which time, the other end of the pivoted arm brings movable contact 36 into engagement with stationary contact 37.

In continuing its course of travel, pin 49 acts on the end of switch arm 43 opposite the contact to swing it outwardly from the center of the disc in the same manner that it acted upon switch arm 38. The swinging of the arm of the switch brings contact 44 into engagement with contact 46.

The shaft 48, driving pointer 3 and cam pin 49, is driven by a motor 50 of the self-starting induction disc type. The speed of the motor is such that it normally will drive the pointer 3 through one complete revolution during the interval of time that the green light is energized.

A lead 51 connects stationary contact 26 of switch 22 to the green light lead 18. Movable contact 27 of switch 22 is connected to a lead 52 through its switch arm 28. Lead 52 interconnects switch arm 28 and contact *a* of switch 23. The movable contact 33 of switch 23 is connected to one terminal of the motor 50, through its switch arm 32 and lead 53. The other terminal of the motor is connected to the common lead 19, through leads 54 and 55.

For the purpose of illuminating the dial lights so that the pointer will be visible at night, a plurality of dial lights 56 is connected across leads 52 and 55.

A lead 57 from the green light lead 18 serves one terminal of solenoid 31. The other terminal of solenoid 31 is connected through lead 58 to stationary contact 37. Movable contact 36 of switch 24 is connected through switch arm 38 and lead 59 to contact 46 of switch 25. A lead 60 is taken from movable contact 44 to common lead 19.

Solenoids 30, 35, and 39 are served by lead 61 from the red light lead 16, as follows: Solenoid

30 is energized by lead 16 through lead 61 and lead 62, and by common lead 19 through lead 63. Solenoid 35 is served from lead 61 by lead 64, and from the common lead 19 through a lead 65, contacts 45 and 44 of switch 25 and its switch arm 43 and lead 60. Solenoid 39 is served directly from lead 61 from the red light lead 18 and through leads 66 and 55 from the common lead 19. Contact *b* of switch 23 is connected to lead 64 for energization of this contact at the appropriate time.

Cycle of Operation

(a) *Normal synchronous operation*

At the time the green light comes on, the various switches of the apparatus are as shown in Figure 2 of the drawing, and the circuit which is energized from the green light circuit is shown in heavy lines. At this time, in other words, the switch 22 is closed, switch 24 is open, the movable contact 33 of the switch 23 is in engagement with the *a* contact of that switch, and the movable contact 44 of switch 25 is in engagement with the stationary contact 46. The pointer is in the starting position, as shown in Figure 2. As the green light comes on, leads 18 and 19 are energized and current flows through the lead 18, the lead 51, switch 26, arm 27, the lead 52, through the contacts *a* and 33 of switch 23 and to the motor 50 through the lead 53; the return circuit from the motor is through leads 54 and 55 back to the common lead 19.

At this time, solenoid 31 is dead due to the fact that the circuit to this solenoid is open at the switch 24. As the green light comes on, the lights 56 are energized since these lights are connected across the leads 52 and 55. The solenoid 30 and the solenoids 35 and 39 are dead since these solenoids are in circuit connection with the red light, which at this time is deenergized.

When the green light is energized, therefore, the motor 50 rotates shaft 48, and the pointer 3 and disc 41 are rotated so that the pin 49, carried on the disc, is moved past the arm 43, permitting the spring 47 to retract the arm 43 and bring contact 44 of switch 25 in engagement with the stationary contact 45 of this switch. At the moment, this actuation effects no electrical change in the circuit since the contact 45 is in the red light circuit which is dead. However, this actuation does prepare a circuit for later energization.

The pin 49 continues to rotate and eventually strikes the arm 42, which in turn effects the closure of switch 24. The closure of this switch likewise does not effect any immediate change in the circuit because, although the solenoid 31 is in circuit connection with switch 24 and subject to actuation from the green light circuit, the circuit to this solenoid was opened when contact 44 of switch 25 left contact 46.

The pin 49 continues to rotate and eventually comes into contact with the arm 43 of switch 25. The pin moves this arm so that contact 44 is returned to engagement with contact 46, completing the circuit through the solenoid 31, which now is energized so as to open switch 22 and break the circuit to the motor 50. Thus, the circuit to the solenoid 31 is from the green light lead 18, through lead 57, solenoid 31, lead 58, switch 24, lead 59, contacts 44 and 46 and lead 60 which is in circuit connection with the common lead 19.

In summary, therefore, the circuit to solenoid 31 is open at switch 24 and closed at switch 25 at the start of the green light interval. Then, as the pin 49 moves past arm 43, the circuit is opened at both switches 24 and 25. Next, as the pin strikes arm 42, the circuit is closed at switch 24 and opened at switch 25, and, finally, as the pin returns to engagement with arm 43, the circuit is closed at switches 24 and 25 and therefore the solenoid is energized; but as soon as it is energized, it opens switch 22 to stop the motor.

Under normal operating conditions, the pointer is at the normal starting position when the red light is energized, switch 24 is closed and switch 22 is open; contact 33 of switch 23 is still in engagement with the *a* contact of that switch, and contact 44 is in engagement with contact 46 of switch 25.

When the red light comes on, current flows from the red light lead 16 through the lead 61, the solenoid 30 and the lead 63 back to the common lead 19, whereupon the solenoid 30 is energized to effect the closure of switch 22. Since this switch is in the green light circuit, there is no electrical change in the circuit conditions.

As the red light comes on, the solenoid 35 is dead since the circuit to this solenoid, through the leads 64 and 65, is opened at switch 25 by virtue of the fact that contact 44 is in engagement with contact 46. Solenoid 39, meanwhile, is energized through the leads 61, 66, 55 and 19; this solenoid, therefore, retracts arm 38 to open the switch which previously was closed by the pin 49 having struck the arm 42 during the preceding green light interval.

When the red light is energized during automatic operation of the device and under the conditions which have just been described, the motor 50 does not operate since the green light is dead, and, the motor cannot derive current from the red light circuit through the *b* contact of switch 23 because contact 33 of this switch is in engagement with contact *a*. Thus, during normal automatic operation of the circuit, when synchronism prevails, current from the red light circuit is utilized only for the purpose of closing switch 22 by energizing solenoid 30 and opening switch 24 by energizing solenoid 39.

Therefore, by the time the red light cycle is completed, all of the switches have been restored to their original positions and the circuit is ready to operate when the green light is next energized.

(b) *Restoration and maintenance of synchronism*

As previously described, it frequently occurs that a traffic officer will operate the primary controller manually. For instance, the traffic officer may deenergize the green light before the pointer has completed its cycle of indication in cases where traffic is very heavy in one direction and sparse in the other. Moreover, signal lights in the muncipalities usually are turned off entirely late at night and at such times the pointer may be stopped in a position other than its normal starting position. The present apparatus is arranged to accommodate such instances by effecting operation of the motor and restoration of the switches to starting positions, through energy derived from the red light circuit. When so energized, the motor drives the pointer until the pointer has reached starting position, and then the apparatus proceeds to operate synchronously until the synchronism is again disturbed.

To illustrate the operation under such conditions, it may be presumed that the pointer has

reached a position as shown, for instance, in Figure 3, when the green light is deenergized. As soon as the green light is deenergized, the motor 50 stops, switch 22 remains closed, contact 33 is in engagement with *a* contact of switch 23, switch 24 is opened and, at switch 25, contact 44 is in engagement with contact 45 (since the pin 49 has moved out of engagement with arm 43 and the spring 47 has retracted the arm). As soon as the red light is energized, current flows through the lead 16, the lead 61, lead 64, solenoid 35, lead 65, through the contacts 45 and 44 of switch 25, and returns through lead 69 to the common lead 19. Energized solenoid 35 now retracts the arm 32 of switch 23 and brings contact 33 of this switch into engagement with the *b* contact thereof, and, consequently, current is permitted to flow to the motor 50 through the leads 16, 61, 64, contacts *b* and 33 of switch 23, the arm 32 and lead 53, with the return circuit from the motor being through leads 54, 55 and 19.

The solenoid 39 also is energized as soon as the red light comes on, with the circuit being through the leads 16, 61, solenoid 39 and the leads 66, 55 and 19. The latter solenoid therefore opens switch 24. (This switch previously was closed since the pin 49 had moved past arm 42 but had not yet reached arm 43.)

The energized motor 50 drives disc 41 until pin 49 engages arm 43 to move contact 44 into engagement with contact 46 and out of engagement with contact 45. As soon as the contact 44 leaves contact 45, the circuit to solenoid 35 is broken. The solenoid becomes deenergized, and spring 34 retracts the arm 32 and brings switch 33 into engagement with the *a* contact thereof.

As soon as contact 33 leaves contact *b* of switch 23, the circuit to the motor 50 is broken and this motor therefore stops, leaving pin 49 in starting position relative to arm 43. Thus, when the motor has restored the pointer to starting condition, its operation is discontinued whether or not the primary red light circuit continues to be energized. At this time, therefore, all switches are in initial starting position, and the circuit is ready for operation by current from the green light circuit when it next becomes active.

During the red light interval, it will be noted, switch 22 is closed, since the solenoid 30 is energized as soon as the red light comes on, the circuit being through leads 16 and 61, solenoid 30, lead 63 and common lead 19.

In the preferred structure, arm 42 is in such a position, relative to arm 43, that pin 49 will actuate arm 42 the instant it leaves arm 43. Therefore, no condition can exist in which the green light, if deenergized, will place the device in an inoperable condition.

It will be seen that the motor 50 may be stopped at the end of the green light interval in one of two ways, depending entirely upon the relative synchronism of the speed of the motor with the green light time cycle. Insofar as the operation of the device is concerned, it makes no difference whether the green light circuit from the primary controller becomes deenergized before the pointer reaches starting position or after the pointer has reached starting position. In the former instance, that is, if the green light goes out before pin 49 has engaged arm 43, then the motor stops running because its supply circuit has become dead, and the incompleted portion of the cycle of the pointer is completed as soon as the red light circuit comes on, as previously described.

On the other hand, if the pointer completes its cycle of revolution before the green light is deenergized, then the pin 49 strikes the arm 43 at the completion of the cycle of the pointer, contact 44 is moved into engagement with contact 46 of switch 25, the circuit to solenoid 31 is completed, and this solenoid opens switch 22 which is in the motor circuit, to disrupt the current supplied to the motor in this manner.

As previously described, it is preferable to adjust the motor speed to green light time interval, so that the green light goes out just as soon as the pointer completes its cycle, since there is less wear and usage of the parts.

Having described our invention, we claim:

1. A signalling device comprised of a circuit including a red light and a circuit including a green light, said circuits including, in common, a primary controller for energizing the lights one after another consecutively for signalling cycles, the said controller usually operating to control the green light for a predetermined interval of time, but capable of being controlled manually for controlling the green light for any desired period of time, a motor, electric circuit means for energizing the motor from the circuit including the green light, an indicator driven by the motor through a cycle of indication during the interval of time the green light normally is energized, said electric circuit for energizing said motor including switch means for deenergizing the motor when the indicator completes one cycle of indication, and circuit switching means for energizing the motor from the red light circuit when the indicator has not completed a cycle of indication before the green light signal is deenergized.

2. A traffic signalling device, comprising, a combination of an electric circuit including a primary circuit controller for energizing a plurality of signals one after another consecutively for signalling cycles, the said primary circuit controller usually operating to control a given one of the signals for a predetermined period of time, but capable of being controlled manually for controlling the given one of the signals for any desired period of time, a motor, electric circuit means for operating the motor through the circuit of the given one of the signals when the circuit is energized from the primary controller, an indicator driven by the motor at a predetermined speed for completion of a cycle of indication during the interval in which the said given one of said signals normally is energized, said electric circuit means for operating said motor including electric switch means for deenergizing the motor when the indicator completes one cycle of indication, and means for driving the motor from the next successive signal circuit when the preceding signal circuit is deenergized before the indicator has completed a cycle of indication, for completion of the cycle of indication.

3. A signalling device comprised of a circuit including a caution signal, a danger signal and a safety signal, said circuit including a primary controller for energizing the signals one after another for signalling cycles, the said controller usually operating to control the safety signal for a predetermined period of time, but capable of being controlled manually for controlling the safety signal for any desired period of time, an indicator, and electric circuit including means for driving the indicator through a cycle of in-

dication during the normal interval in which the safety signal is energized, circuit means including the safety signal circuit for energizing the electric driving means when the safety signal is normally energized, switch means in connection with said electric circuit for driving said indicator, said switch means operated by said indicator when the indicator completes a cycle of indication for deenergizing the electric drive, and circuit switching means including a switch responsive to the position of the indicator for energizing the electric drive means through the danger signal circuit if the safety signal is deenergized before the indicator has completed a cycle of indication.

4. A traffic signalling device of the class described, comprising, a first signal circuit and a second signal circuit, said circuits normally being energized consecutively each for a predetermined period of time, but with the said first signal circuit occasionally being energized for a timed interval different from the predetermined period, a motor normally in circuit connection with the first signal circuit for operation when the first signal circuit is energized, an indicator in driving connection with the motor for operation through a cycle of indication during the period of time in which the first signal circuit normally is energized, circuit switching means actuable responsively to the position of the indicator and providing circuit connection of the motor to the second signal circuit, whereby the motor is driven therefrom for completing the cycle of indication of the indicator if the first signal circuit is deenergized before the indicator has completed a cycle of indication, and switch means actuable in response to the completion of the cycle of indication for uncircuiting the motor from the second signal circuit and reestablishing circuit connection to the motor from the first signal circuit for operation of the motor when the first signal circuit is next energized.

5. A traffic signalling device of the class described, comprising, a first signal circuit and a second signal circuit, said circuits normally energized consecutively each for a predetermined period of time but with the first signal circuit occasionally being energized for a timed interval different from the predetermined period, a motor normally in circuit connection with the first signal circuit for actuation in unison therewith, an indicator in driving connection with the motor, the said motor normally driving the indicator through a complete cycle of indication during the period of energization of the first signal circuit, a circuit controlling switch having actuating means connected with the second signal circuit, the said actuating means being adapted to operate said circuit controlling switch for deenergizing the motor when the indicator has completed a cycle of indication, and means for maintaining synchronism between the position of the indicator and the intervals of energization of the first signal, comprising, circuit switching means effective for energizing the motor through the second signal circuit when first signal circuit is deenergized before the indicator has completed a cycle of indication.

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