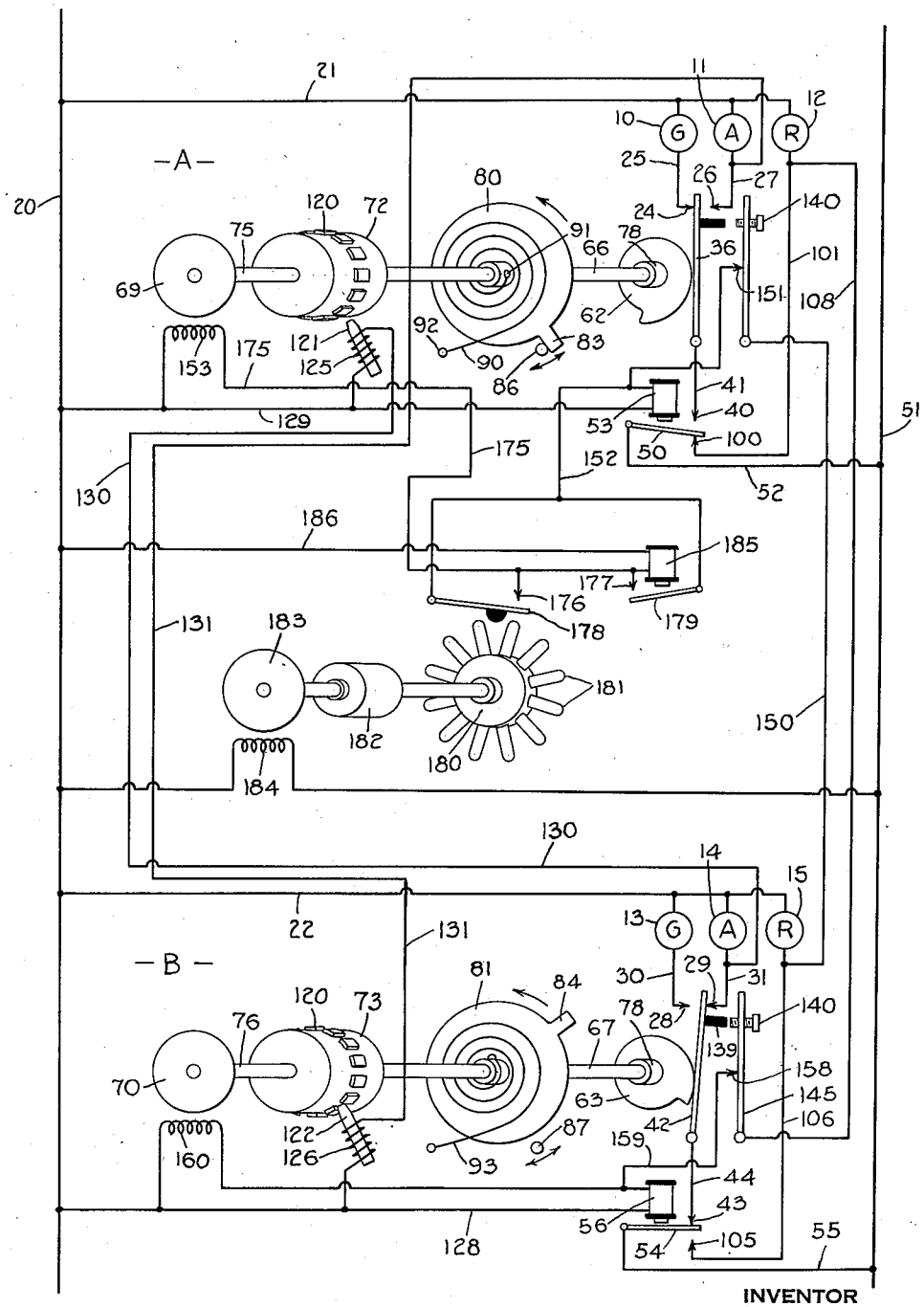
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SYNCHRONOUS CONTROLLER

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SYNCHRONOUS CONTROLLER

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This invention relates to controllers and, for convenience, is shown applied to a controller of the kind set forth in my prior Patent No. 2,324,051, dated July 13, 1943.

Such controllers consist essentially of a plurality of units for controlling the green, amber and red signals at street intersections, each unit including an intermittently operated timer motor adapted, when energized, to move from an initial stop position through a cycle, to successively control the green, amber and red signals of one street. The arrangement is such that the cycle of the unit for one street at the intersection, including the energizing of its green signal and its timer motor, is initiated in response to the coming on of the red signal of the unit for another street at that intersection. Thus, if there are two streets at the intersection (the ordinary crossing) two units are provided, whereas if there are three streets at the intersection, three units are provided, and, in all cases, a unit reaching its red light phase starts up the cycle of a second unit, and when that second unit reaches its red light phase, it starts up the cycle of the first unit, if there are only two, or of the third unit, if there are three, and so on.

Being thus electrically tied together and operable only in sequence, the several units of any one controller cannot get out of step or display conflicting signals. However, it is mechanically impossible or, at least, not practical in apparatus of this character, to eliminate the chance of the cycle of one or more units of a controller, or of a series of controllers, from varying by a small amount; and while such variations may be no more than a fraction of a second, they are apt to be cumulative and the number of cycles completed in a given period is such that the total variation may quickly become substantial.

The object of the present invention is to provide a controller of the type of the said prior patent which is synchronous.

The invention will be readily understood from the following description in connection with the accompanying diagram showing a two-unit controller having the invention applied to it.

The two units are designated A and B. The green, amber and red lights controlled by unit A are designated 10, 11 and 12; those controlled by unit B as 13, 14 and 15. For convenience, the green, amber and red signal lights are lettered G, A and R, respectively, in each unit.

As described in the aforesaid prior patent, the signal lights 10, 11 and 12 are connected to the common side 20 of the supply through a wire 21 and the signals 13, 14 and 15 are connected to the side 20 through wire 22. The green signal 10 is connected to contact 24 through wire 25, and the amber light 11 to a contact 25 through wire 27. In like manner, the green and amber signals 13, 14 are connected to contacts 28, 29 respectively through wires 30, 31.

A movable contact 36 is arranged to be moved into and out of engagement with the contacts 24, 26, and is connected to a stationary contact 40 through wire 44 and the contacts 28, 29 are controlled by movable contact 42 connected to stationary contact 43 through wire 44.

Contact 40 is energized by the armature or movable contact 50 connected to the hot side 51 of the supply through wire 52. The armature 50 is under the control of a relay coil 53. The contact 43 of unit B is energized by armature 54 connected to wire 51 through wire 55, the armature being under the control of relay coil 56.

The contacts 36, 42 are actuated into and out of engagement with their associated stationary contacts by cams 62, 63. These cams are mounted upon and rotate with control shafts 66, 67, respectively, these shafts being rotated by motors 69, 70, through reduction gearing arranged in the respective gear housings 72, 73. The motors 69, 70 are connected to the gearing in housings 72, 73 through their shafts 75, 76, respectively. The gear housings are rotatably mounted upon the shafts 66, 75; 67, 76. The cams 62, 63 may be insulated from their shafts 66, 67 by being mounted upon discs 78 of insulating material.

A helical spring 90 is secured at its inner end to shaft 66, as at 91, and at its outer end to a fixed point 92. The arrangement is such that when the shaft 66 is rotated to move the cam 62 through its arc of rotation, the spring 90 is wound up. That is, the rotation of the shaft 66 is against the tension of the spring and, accordingly, the spring 90 yieldingly urges the shaft 66 and the associated cam 62 back to its initial position. Similarly, a spring 93 is associated with shaft 67.

The cam 62 in unit A is in its initial or starting position with movable contact 36 in engagement with contact 24. However, the green signal 10 is not illuminated due to the fact that relay 53 is de-energized and its armature 50 is out of engagement with contact 40 and is dropped into engagement with stationary contact 100 which is connected to the red lamp 12 through wire 101. Accordingly, the red light is energized on street A.

Cam 63 of unit B has traveled through a portion of its arc of movement and is so positioned that it has moved the contact 42 into engagement with contact 29. Inasmuch as the relay in unit B is now energized, a hot feed is provided to the amber light through wire 55, armature 54, contact 43, wire 44, contacts 42, 29, and wire 31. Relay 56 in unit B is energized through wire 52, armature 50, contact 100, wire 101, wire 108, movable contact 145, stationary contact 158, wire 159 and, from coil 56 to the common side 20, through wire 128. Wire 159 is also connected to coil 160 of motor 70. Accordingly, the motor 70 is energized and is operating to effect rotation of cam 63, which has just shifted the movable contact 42 from contact 28 to contact 29, effecting a shift from the green signal 13 to the amber signal 14 of unit B.

The gear housings 72, 73 are each provided with radially extending projections 120, and the respective units are provided with detents 121, 122 normally engaging the projections 120 and being withdrawn from engagement therewith by the respective solenoid coils 125, 126. The coil 126 is connected to the wire 128 and the coil 125 to the wire 129. The opposite side of coil 125 is connected through wire 130 to the feed wire 31 for the amber lamp 14 on street B. The other side of the coil 126 is connected through wire 131 to the feed wire 27 of the amber lamp 11 for street A. Accordingly, inasmuch as amber lamp 14 on street B is illustrated as energized, the coil 125 is likewise energized, moving the detent 121 out of engagement with the projections 120 on gear housing 72.

The reduction gearing in the housings 72, 73 is of the planetary type and functions when the housings are held against rotation of effect rotation of the cam shafts by the respective motors. Due to the relatively great reduction in the gearing arranged in each of the housings 72, 73, the housings are in practical effect, insofar as retrograde movement is concerned, coupled to the respective shafts 66, 67. Accordingly, when the shafts 66, 67 have been rotated through their cycle or arc of movement by their respective motors against the tension of the springs 90, 93, and thereupon the detents 121, 122 are withdrawn from the projections 120, the housings 72, 73, and their associated shafts 66, 67 are rotated backwards by the springs 90, 93. Shaft 66 has been so rotated by its spring and the backward movement arrested by the engagement with a stop 86 of the ear 83 of a disc 80 secured to the shaft. A similar disc 81, ear 84 and stop 87 are provided for unit B. As explained in my said prior patent, the stops 86, 87 are adjustable to vary the duration of the green signals.

It will be noted that the motor coil 160 of timer motor 70 of unit B is connected on one side to wire 128 and main 20 and on its other side to wire 159. By contrast, whereas one side of motor coil 153 of timer motor 69 is connected to wire 129 and main 20, the other side of motor coil 153 is connected by wire 175 to stationary contacts 176, 177. The latter contacts are energized, respectively, by movable contacts 178, 179 which are connected in parallel to wire 152 and thence to relay 53 and stationary contact 151.

Contact 178 is the armature of a make-and-break device diagrammatically indicated as consisting of a disc 180 carrying a plurality of radially projecting elements 181. Armature 178 is normally biased to open circuit position and is repeatedly moved to engage contact 176 by the elements 181 upon rotation of disc 180. The latter may be driven, through reduction gearing 182, by a synchronous motor 183, the coil 184 of which is shown connected across the mains for continuous operation. Contact 179 is likewise biased to normally open position and is moved to engage contact 177 upon energization of relay 185 which, as indicated, is connected by wire 186 to main 20.

When, now, cam 63 of unit B advances to the point of causing the insulating member 139 carried by element 42 to engage set-screw 140 and disengage element 145 from contact 158, the circuit of relay coil 56 is broken and element 54 dropped into engagement with contact 105. Thereupon, the amber light of unit B is extinguished, the circuit of its red light is completed and, through wire 106, wire 150, contact 151 and wire 129, current is supplied to energize the relay coil 53 of unit A and raise element off its "red light contact" 100 (extinguishing that light) into engagement with contact 40 to complete the green light circuit of unit A.

Even though wire 152 is now live, it will be noted that the motor coil 153 of timer motor 69 is not energized until one of the elements 181 carried by disc 180 closes the switch 178, 176. Such closure serves to energize holding coil 185 of switch 179, 177 so that a holding circuit for switch 179, 177 is established and through which motor coil 153 continues to be energized (notwithstanding the repeated circuit interruptions at switch 178, 176) until the current to wire 152 is interrupted. That occurs when cam 62 reaches the end of its travel, after successively extinguishing the green light 10, lighting the amber light 11 and, finally, breaking the circuit of relay coil 53 to extinguish the amber light of unit A, illuminate the red light of unit A and coincidently, complete the green light circuit of unit B.

It will be apparent that while the green light of unit A is illuminated in immediate response to the coming on of the red light of unit B and even though wire 152 is rendered live at the same time, the starting of timer motor 69 of unit A has to wait upon the closure of switch 178, 176 by the synchronizer. That is to say, while the green light cycle of unit A is initiated by unit B, its duration (which is dependent upon the operation of motor 69) is determined by the precise timing of the synchronizer. Obviously, also, the controller is thus synchronized once in every cycle, whatever it may be. As described in my said prior patent, the adjustment of stops 86, 87 to vary the green signals can be effected by suitable knobs movable over scales calibrated in seconds; and the durations of the amber signals can likewise be effected by similar knobs movable over scales calibrated in seconds, these latter knobs performing the function of adjusting screws 140.

The short, equal intervals at which the make-and-break device operates may conveniently be referred to as sub-multiples of the time cycle of the controller. In practice, the time cycle of the controller is established (that is, manually adjusted in the manner described) to a total slightly less than an actual multiple of the speed of operation of the make-and-break device. For example, if the disc 180 is driven at a speed of, say, one revolution per minute, twelve elements 181 may be employed so as to effect closure of switch 178, 176 at five second intervals. If, then,

the controller cycle were manually set for, say, forty-seven seconds, the synchronizer would actually start up unit A motor at the fifty second contact by one of the elements 181. Or, for example, if the controller cycle were set for sixty-two seconds, the synchronizer would delay the start of motor 69 of unit A until the sixty-five second contact had been made by one of the elements 181. In any case, the superseding control by the synchronizer prevents the accumulation of such minor variations in timing as may result from mechanical causes in the units themselves.

In the use of the controller, the required manual setting of the time cycle at a figure slightly less than an actual multiple of the speed of operation of the make-and-break device can readily be accomplished by an instruction, calling for the setting of the cycle at a figure, say, three seconds less than that actually required for the green light on street A.

While, for clarity of illustration, two separate switches 178, 176 and 179, 177 have been shown in the diagram, it will be apparent that the make-and-break actuator (in this instance represented by elements 181) can be arranged to operate directly upon switch 179, 177 and switch 178, 176 dispensed with. The operation will be as already described. That is to say, the circuit of coil 153 of timer motor 69 will not be energized until switch 179, 177 is closed by the synchronizer and such closure will coincidently close the circuit of relay coil 185 and hold switch 179, 177 closed and unaffected by elements 181 until the cycle of unit A is again to be initiated.

By means of this invention there is thus provided a synchronous controller the cycle of which can be changed at will without the necessity of changing the speed of rotation of the control shaft, as by changing gears or otherwise. It will also be apparent that the described synchronizer is equally effective in connection with non-synchronous controllers of other types than the one herein shown and described for purposes of illustration.

The following is claimed:

1. In a traffic signal controller for controlling the green, amber and red signals on each street of an intersection having two or more streets, comprising an individual control unit for each street, each control unit including an intermittently operated timer motor operable when energized to move from initial position through a cycle to successively control the green, amber and red signals on its street, and means responsive to the display of the red signal of one unit for supplying current to the green signal of another unit and, in parallel, to the timer motor circuit of such other unit, the improvement which comprises: a holding circuit in parallel with the said timer motor circuit; a relay in said holding circuit; a switch responsive to the energization of the said relay and controlling both the holding circuit and the said timer motor circuit; an actuator adapted for energizing said relay; and a continuously operating synchronous motor for operating said actuator at equal intervals representing sub-multiples of the time cycle of the controller.

2. In a traffic signal controller for controlling the green, amber and red signals on each street of an intersection having two or more streets, comprising an individual control unit for each street, each control unit including an intermittently operated timer motor operable when energized to move from initial position through a cycle to successively control the green, amber and red signals on its street, and means responsive to the display of the red signal of one unit for supplying current to the green signal of another unit and, in parallel, to the timer motor circuit of such other unit, the improvement which comprises: a switch in the timer motor circuit of said other unit, said switch being biased to open-circuit position; a continuously operating synchronous motor; a shaft driven by the synchronous motor having at least one element positioned to close said switch at equal intervals representing sub-multiples of the time cycle of the controller; a relay adapted to be energized in response to closure of said switch; and a timer motor holding circuit controlled by said relay.

3. In a traffic signal controller for controlling the green, amber and red signals on each street of an intersection having two or more streets, comprising an individual control unit for each street, each control unit including an intermittently operated timer motor operable when energized to move from initial position through a cycle to successively control the green, amber and red signals on its street, and means responsive to the display of the red signal of one unit for supplying current to the green signal of another unit and, in parallel, to the timer motor circuit of such other unit, the improvement which comprises: a switch in the timer motor circuit of said other unit, said switch being biased to open-circuit position; a continuously operating synchronous motor; a reduced speed shaft driven by the synchronous motor having a plurality of equally spaced elements positioned to close said switch at equal intervals representing sub-multiples of the time cycle of the controller; a relay adapted to be energized in response to closure of said switch; and a timer motor holding circuit controlled by said relay.

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