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CONTROL APPARATUS FOR TRAFFIC SIGNALING SYSTEMS

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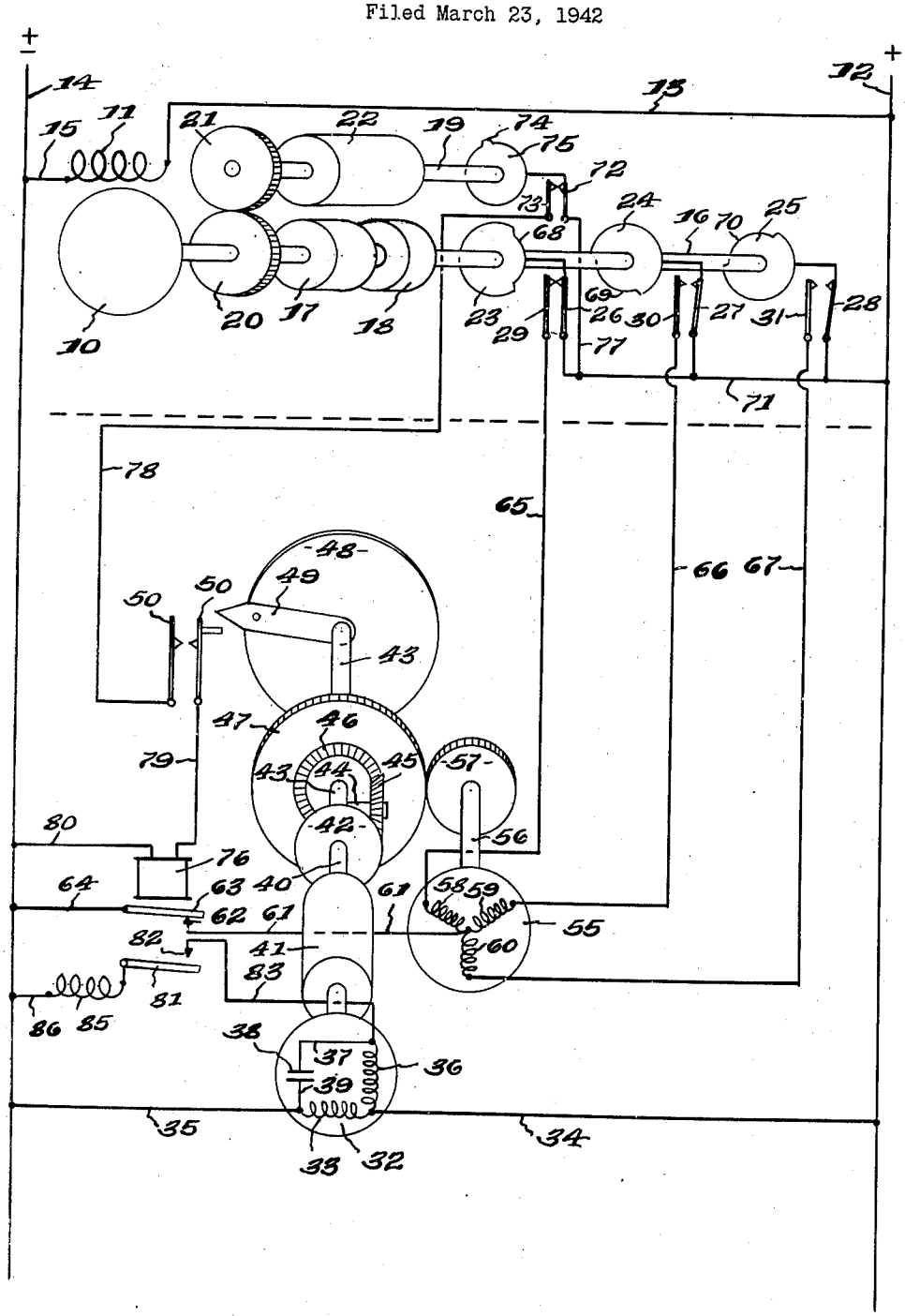

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CONTROL APPARATUS FOR TRAFFIC SIGNALING SYSTEMS

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1

This invention relates to a variable speed controller for traffic signaling systems. Those familiar with the art are well aware of the fact that the traffic signals in congested areas are operated on an interconnected system, the control apparatus being such as to operate the signals at the various intersections of the system in a predetermined timed relation in order to effect the most efficient movement of traffic in the area. These systems are sometimes termed progressive systems and operate in such a manner that the signals at the intersections operate progressively one after the other so that platoons of traffic can travel on the street continuously without being stopped at any intersection. In order to function in this manner, it is necessary that the secondary controllers at the various intersections be interconnected and be supervised by a master timer in order that the predetermined timed relation between the signals at the various intersections will be maintained.

In many instances, it is desirable to vary the operation of such systems during various times of the day by varying the speed of the secondary timers. To vary the speed of the secondary timers and at the same time maintain all such timers of the system in step or predetermined timed relation, presents a problem of some magnitude. In order to maintain the secondary timers in step, it is preferable to operate them with a synchronous motor and in systems where this has been done, it has been proposed to change the speed of the secondary timers by means of shifting gears in a gear transmission arranged between the secondary timers and their respective motors. The gear shifting idea runs into complicated and costly structure which frequently gets out of commission.

In lieu of the gear shifting structure, it has been proposed to arrange a friction clutch between the driving motor and the secondary timer and to periodically engage and disengage this clutch from headquarters. This clutch arrangement is more economical than the gear shifting transmission but also results in high maintenance cost and has the disadvantages of getting the secondary timers out of step with the master timer and in providing only for the extension of the traffic signal period by slowing down the timer. Or, in other words, the speed of the timer can not be increased to shorten the total period of the timer. If the gear shifting idea, or the clutch idea, is not employed, it is necessary to have duplicate switching apparatus associated with each secondary timer and this also results in a complicated and costly structure, it being necessary to have a switching apparatus for each change of speed desired.

2

This invention has to do particularly with a traffic signal control apparatus for a progressive system, the secondary timers of which are operated by a synchronous motor, and the invention has as an object a particularly economical and efficient means for varying the speed of the secondary timers.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is made to the accompanying drawing in which like characters designate corresponding parts in all the views.

The drawing is a schematic, across the line diagram illustrating my invention.

For purposes of illustration, I have shown one master timer and one secondary timer. However, it will be apparent, as the description proceeds, that any number of secondary timers may be included in the system.

The master timer consists of a synchronous motor 10 operated by driving coil 11, one side of which is connected to the hot source 12 by wire 13, and the other side to the common return 14 by wire 15. The motor 10 is operatively connected to a cam shaft 16 by means of a variable speed transmission 17 and a reverse gearing 18. The timer also includes a second cam shaft 19 connected to the shaft 16 by reducing gears 20, 21, and a change speed transmission 22. A series of cams 23, 24, 25 are mounted upon the shaft 16 and function to operate movable contacts 26, 27, 28 respectively, and these contacts are cooperable with stationary contacts 29, 30 and 31 respectively.

The secondary timer is operated by a synchronous motor 32 here shown as a capacitor start-capacitor run type of motor, the driving coil 33 is connected to the hot source 12 by wire 34 and to the common return 14 by wire 35. The auxiliary coil 36 is connected at one side to the wire 34 and at the other side to the wire 35 through wire 37, condensor 38, wire 39.

The motor 32 is connected to a shaft 40 through the medium of a suitable gear reducer 41. The shaft 40 is provided with a driving gear 42. A driven shaft 43 is provided with a laterally extending member 44, on the outer end of which is journalled a beveled gear 45. The beveled gear 45 is arranged in mesh with the driving gear 42 and with a driven gear 46 associated with a spur

gear 47. The gears 46, 47 are integral or tied together and both are freely rotatable upon the shaft 43. The shaft 43 is provided with the conventional cams for operating the switches in the traffic signal circuit. The cams and switches are not shown inasmuch as they may be of any conventional construction as used on all traffic signal timers. The shaft 43 is also provided with a dial 48 and an offset arm 49 which may be adjusted circumferentially around the dial 48 and which is cooperable to move a movable contact 50 into engagement with a contact 51, this structure constituting part of the resynchronizing mechanism to maintain the secondary timer in step with the master timer.

It will be apparent that unless the gears 46, 47 remain stationary, the motor 32 will not effect rotation of shaft 43 because of the planetary or compensating gearing 42, 45, 46. If the gears 46, 47 are maintained stationary, the motor 32 will drive the shaft 43 at a predetermined speed depending upon the speed of the synchronous motor, the reduction of the gearing 41, and the ratio of the compensating gearing.

The secondary timer also includes an electro-responsive device cooperable with the compensating gearing to vary the speed at which the motor 32 operates the timer shaft 43. As here shown, the electro-responsive device is in the nature of a second motor 55 operatively connected to shaft 56 provided with a gear 57 arranged in mesh with the gear 47. The motor 55 is of the impulse type. As here shown, it is provided with three energizing coils 58, 59, 60. When any one of the coils 58, 59, 60 is energized, the motor is caused to move through a predetermined arc. Corresponding sides of all of the coils are connected to the common return 14 through wire 61, contact 62, relay armature 63, wire 64. The opposite side of the coil 58 is connected to the contact 29 through wire 65. The opposite side of the coil 59 is connected to the contact 30 through wire 66, and the coil 60 is connected to the contact 31 through wire 67. Each of the master timer cams 23, 24, 25 is so formed as to permit the movable contacts 26, 27, 28 to engage the respective stationary contacts 29, 30, 31, while the movable contacts engage the low portions 68, 69, 70 of the cams 23, 24, 25 respectively. The contacts 26, 27, 28 are connected to the hot feed 12 by wire 71. These cams are so arranged on the shaft 16 as to successively close the contacts, and each pair of contacts remain closed until after the engagement of the succeeding pair of contacts, whereby one of the coils 58, 59, 60 is always energized. As previously stated, upon energization of each of the coils of motor 55, the motor is thereupon rotated through a predetermined arc and then locked in this position as long as the coils remain energized. This being the case, in the absence of any rotation of gear 57, the gear 47 is held stationary permitting the synchronous motor 32 to rotate the cam shaft 43 at the predetermined fixed speed. However, any rotation of the motor 55 and accordingly the gears 57, 47, either adds to or subtracts from the rotation of shaft 43, this because of the compensating gearing described. The direction of rotation of the motor 55 depends upon the sequence in which the coils 58, 59, 60 are energized which, in turn, depends on the direction of rotation of the cam shaft 16 by reverse gearing 18. However, the motor 32 and gearing 41 may be arranged to operate the cam shaft 43 at the highest speed required and the master timer and motor 55 employed to subtract from this maximum speed which, in effect, produces an increase in the total period of the traffic signal displayed, this because the cam shaft 43 is reduced in speed.

For example, assume that the motor 32 and gearing 41 is effective to drive the shaft 43, when the gears 46, 47 are stationary, at a speed of 1 R. P. M. This means that the shaft 43 moves 6° per second. Assume now that each time one of the coils 58, 59, 60 is energized, the motor 55, through the gearing 57, 47, sets the shaft 43 back ¾ of 1°. It will then take the shaft 43 one-eighth of a second to regain this lost travel each time a coil of motor 55 is energized. Therefore, if the motor 55 receives eight impulses, one second has been added to the time required for the shaft 43 to make one revolution. It is apparent that with each revolution of the shaft 16, the motor 55 receives three impulses. Accordingly, if the shaft 16 is operated at 40 R. P. M. the motor 55 will receive one hundred and twenty impulses per minute. This will add fifteen seconds to the time required for the shaft 43 to complete one revolution. However, due to the fact that the shaft 43 has been periodically set back during the minute interval, the total period will not only be extended for the fifteen seconds but in fact for a slight additional period of approximately five seconds, whereby the total period is actually extended from sixty seconds to about eighty seconds.

It will be understood that, as is conventional, the master timer will be located at headquarters where the gearing 17, 18 may be conveniently adjusted by the operator in charge.

It will also be apparent that the variable speed transmission 17, 22 are adjustable simultaneously and these transmissions, together with the reducing gearing 20, 21, function to maintain a certain predetermined ratio between the shafts 16, 19. The reverse gearing 18 is employed only to reverse the progression of the switches 26, 27, 28.

As is the custom in systems of this kind, the secondary timers of the system are periodically checked for synchronism with the master timer. As here shown, this is accomplished in the following manner. Once during each revolution of the shaft 43, the contact 50 is moved into engagement with contact 51 by offset arm 49. If the secondary timer is not in step with the master at the time the contacts 50, 51 close, the contacts 72, 73 will not be opened by the lobe 74 on cam 75, and relay 76 will be energized by the following circuit. Wires 71, 77, contacts 72, 73, wire 78, contacts 50, 51, wire 79, relay 76, wire 80, to the common return 14, the relay 76 being energized, the armature 63 is moved out of engagement with contact 62 thus breaking the return circuit for the coils of motor 55. Also, the armature 81 will be moved into engagement with contact 82 which is connected to one side of coil 36 of motor 32 by wire 83. The armature 81 is connected to one side of a reactor 85, the opposite side being connected to the common return 14 through wire 86. Thus, the reactor 85 is shunted across the condensor 38, causing the motor 32 to stop.

With both of the motors 32, 55 stopped, the secondary timer remains stationary in this position until the contacts 72, 73 are opened, breaking the circuit to relay 76 and permitting the secondary timer to resume operation. If the secondary timer is in step with the master, simultaneously with the closing of the contact 50, 51, the contacts 72, 73 are opened and the secondary timer does not stop or dwell. The off-

set arm **49** is adjustable circumferentially of the disk **48** in order to maintain the desired relative relationship between all of the secondary timers. This portion of the control having to do with maintaining the secondary timers in synchronism with the master timer per se forms no part of this invention.

It will be apparent that the display of the traffic signals may be conveniently varied from headquarters by adjusting the gearing **17**, **18** of the master timer which, through the motor **55**, either adds to or subtracts from the speed at which shaft **43** is driven by motor **32**.

It will also be apparent that a solenoid operated ratchet and pawl device can obviously be substituted for the impulse motor **55** and if two of such devices are employed with the pawls operating in opposite directions, the structure will function to increase or decrease the speed of the shaft **43**.

What I claim is:

1. A traffic signal control apparatus for an inter-connected signal system comprising a master timer and a secondary timer, said secondary timer including a driving motor, motion transmitting means including compensating gearing connecting said motor to the timer, a series of switches periodically operable by the master timer in a predetermined succession, an electro-responsive impulse device connected to said gearing and said device having a series of driving coils, each coil being connected in circuit through one of said switches, and said device being cooperable with said gearing as each coil is connected in circuit to vary the speed of the secondary timer.

2. A traffic signal control apparatus for an interconnected signal system comprising a master timer and a secondary timer, said secondary timer including a driving motor, motion transmitting means including compensating gearing connecting said motor to the timer, a series of switches periodically operable by the master timer in a predetermined succession, an electro-responsive impulse device connected to said gearing and said device having a series of driving coils, each coil being connected in circuit through one of said switches, and said device being cooperable with said gearing to increase the speed of the secondary timer when said switches are operated by the master timer in succession in one direction, and to decrease the speed of the secondary timer when said switches are operated in succession in the opposite direction, and means associated with the master timer and operable to reverse the succession of operation of said switches.

3. A traffic signal control apparatus for an interconnected signal system comprising a master timer and a secondary timer, said secondary timer including a driving motor, motion transmitting means connecting said motor to the timer and including compensating gearing, an electro-responsive device connected to said gearing, said driving motor being operable to drive the secondary timer at a predetermined constant speed while said electro-responsive device is inoperative, means operable by the master timer to periodically energize said electro-responsive device during each revolution of the secondary timer, and said device being cooperable with said gearing upon each energization to vary the speed of the timer a predetermined amount.

4. A traffic signal control apparatus for an inter-connected signal system comprising a master timer and a secondary timer, said secondary timer including a driving motor, motion transmitting means connecting said motor to the timer and including compensating gearing, switch means actuated periodically by the master timer during each revolution of the secondary timer in either of two successions, an electro-responsive device connected to said gearing, a circuit connecting said switching means to said electro-responsive device, said electro-responsive device being cooperable when said switching means is actuated in one succession to increase the speed of the timer a pre-determined amount and when actuated in the other succession to decrease the speed of the secondary timer a predetermined amount, and means associated with the master timer for varying the speed of actuation of said switching means by the master timer, all whereby the speed of the secondary timer may be increased or decreased by the master timer.

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