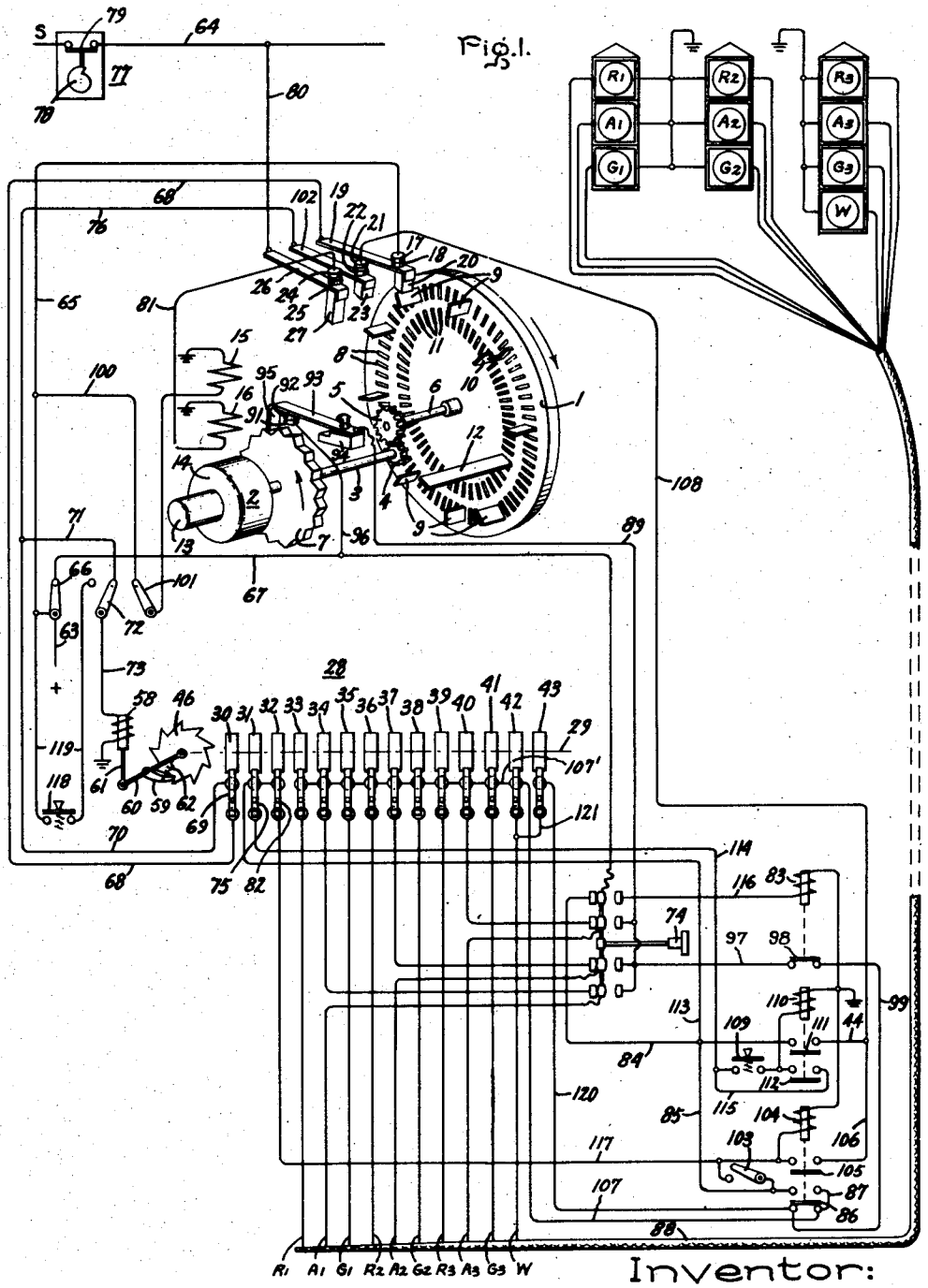
June 5, 1951 W. C. PENNELL 2,555,994

TRAFFIC SIGNAL CONTROLLER WITH PEDESTRIAN ACTUATION

Filed Feb. 18, 1949 2 Sheets-Sheet 1

Fig. 1.



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Filed Feb. 18, 1949 2 Sheets-Sheet 2

Fig. 2.

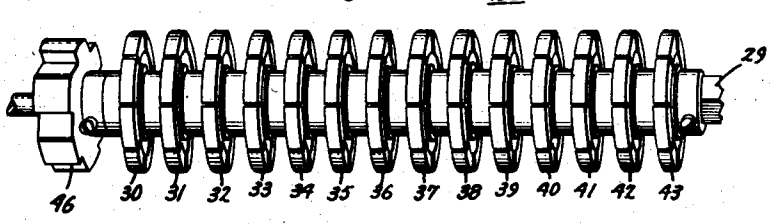

Fig. 3.

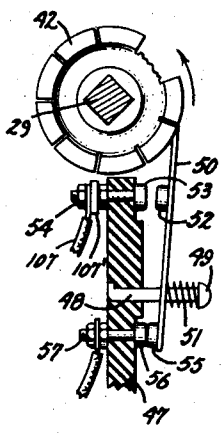

Fig. 4.

SIGNAL SEQUENCE				POSITION OR INTERVAL	DISC NO.													
STREETS					30	31	32	33	34	35	36	37	38	39	40	41	42	43
MAIN 1	MAIN 2	CROSS	PED.					R_1	A_1	G_1	R_2	A_2	G_2	R_3	A_3	G_3	W	fW
G	R	R		1	X	X	X			X	X			X				
G	G	R		2	X	X	X			X			X	X				
G	G	R		3	X	X	X			X			X	X				
A*	A*	R*		4		X			X			X		X				
A	A	R		5	X	X	X		X			X		X				
R	R	G	W	6	X		X	X			X					X	X	
R	R	A	fW	7	X	X	X	X			X				X			X
R	R	R	fW	8	X	X	X	X			X			X				X
R	R	R		9	X	X	X	X			X			X				

R-RED LIGHT
A-AMBER LIGHT
G-GREEN LIGHT
W-WALK LIGHT
fW-FLASHING WALKLIGHT
*-FLASHING UNDER CERTAIN CONDITIONS
X-DISC SECTION BROKEN OUT (CIRCUIT CLOSED)

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TRAFFIC SIGNAL CONTROLLER WITH PEDESTRIAN ACTUATION

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6 Claims. (Cl. 177—337)

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This invention relates to traffic signal controllers, and more particularly to traffic signal controllers which have provision for pedestrian actuation.

It is an object of the invention to provide an improved traffic signal controller of the pedestrian actuated type.

A further object of the invention is the provision of a pedestrian actuated traffic signal controller which is operable in an interconnected system with other traffic signal controllers.

Another object of my invention is the provision of a traffic signal controller, operable in an interconnected system, which is responsive to pedestrian actuation but which will give the walk signal for pedestrian crossing of the intersection only when vehicular traffic is at a minimum as a result of the action of other traffic controllers in the interconnected system.

A still further object of my invention is the provision of a traffic signal controller which has the pedestrian actuation features mentioned above but which can be readily transferred to continuous cyclic operation.

In carrying out my invention in one form, I provide a traffic signal controller having a continuously rotating dial on which are located a number of switch actuating keys. The switches operated by these keys cause, by means of a solenoid operated ratchet and pawl mechanism, the step-by-step rotation of a contactor operating drum. The drum operates contactors which control the traffic signal lights at a street intersection. Normally, the controller causes a flashing amber right-of-way signal to be given continuously on the main street or streets and a flashing red stop indication to be given on the cross street. However, one or more push-button stations are provided near the intersection, for pedestrian operation, which cause the traffic signal controller to go through a complete cycle of signals, including a walk signal for pedestrian crossing of the main streets. The controller is arranged for interconnection with other traffic signal controllers in a progressive system in a manner such that the walk signal will be given only when vehicular traffic is at a minimum, as a result of the action of the other controllers. Provision is also made for transferring the controller from pedestrian actuated operation to continuous cyclic operation or to uninterrupted flashing operation.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a schematic

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electrical circuit diagram of one preferred embodiment of my invention; Fig. 2 is a perspective view of the drum controller which is incorporated in this embodiment; Fig. 3 is a sectional side view of one typical disc on the drum controller illustrating the detailed construction of this disc and the contactor which is operated by the disc; and Fig. 4 is a tabulation showing in detail a signal sequence for this controller.

Referring to Fig. 1 of the drawing, there is illustrated a circular dial 1 which is rotated continuously by a synchronous motor designated generally by the numeral 2. Motor 2 drives dial 1 in the clockwise direction through a motor shaft 3, a pinion 4 mounted on the motor shaft, a gear 5 and a dial shaft 6. Star wheel 7, the operation of which is explained in detail later, is also mounted on motor shaft 3, where it is rotated counterclockwise by motor 2.

The dial 1 is provided with radial slots 8 arranged in a circle about the center of the dial. A plurality of keys 9 and one key 10 having a cut-out portion are located in selected ones of slots 8. The relative positions of keys 9 and key 10 to each other determines the relative lengths of individual signal periods during cyclic operation of the traffic signal controller, while the position of key 10 also maintains dial 1 and a drum controller 28, the operation of which is explained in detail later, in the correct relative positions. A second group of radial slots 11 is arranged in a smaller circle about the center of dial 1. A key 12, which is similar to keys 9, but is longer, is located in a selected one of slots 11. The location of key 12 determines the time relationship of the signal cycle of this controller, during cyclic operation, to the signal cycles of other controllers in an interconnected system.

The synchronous driving motor, which is indicated generally by the numeral 2, is preferably a self-starting synchronous motor of the type disclosed in U. S. Patent 1,430,867, issued to H. E. Warren. The motor 2 comprises a tubular casing 13 attached to a larger casing 14. The tubular casing 13 encloses an armature shaft which is connected to speed reducing gears in the casing 14. The speed reducing gears drive motor shaft 3. A field winding 15, which is mounted adjacent to the outer surface of casing 13, causes a rotation of the armature and motor shafts when the field winding is energized. The motor 2 is a modification of the motor described in Patent No. 1,430,867, in that the casing 13 is lengthened and two armatures are provided on the shaft therein. One of the armatures cooperates with the field

15 and the second armature cooperates with a second field 16. The two fields 15 and 16 are mounted near the outer surface of casing 13 in operative relation to the two armatures, respectively, to effect a rotation of the armature shaft in opposite directions. The fields 15 and 16 are of equal magnetic strength so that if they are simultaneously energized, the armature and motor shafts are stopped. Only one field, field 15, is, therefore, normally energized with the second field, field 16, being energized only when it is desired to stop the motor instantly.

This self-starting synchronous motor, which may be stopped substantially instantly, provides a precise control of the timing dial from a remote point, during cyclic operation of the traffic controller, since the motor will not coast appreciably after the braking current is applied. The motor stops and starts substantially instantly and no inaccuracy results when the controller resynchronizes with other controllers in an interconnected system.

The motor 2, being a synchronous motor, runs at a constant speed dependent upon the frequency of the electrical current which is supplied thereto. The speed of dial 1 is determined by the gear ratio of pinion 4 and gear 5. The time required by the dial 1 to make a complete revolution determines the length of a cycle of operation and the spacing of the keys 9 and 10 in the dial slots 8 determines the time intervals into which a cycle is divided. The location of key 12 in the inner concentric circle of slots 11 determines the relationship of the signal cycle of this controller to the signal cycles of other interconnected controllers.

In order to convert the above-mentioned key spacings into correspondingly timed traffic signal operations, three switches are provided adjacent to the annular paths of rotation of the keys. Each such switch has a fixed contact, a movable contact mounted on a flexible spring-like member and a block which engages the keys. The switch nearest the dial has a fixed contact member 17, a movable contact member 18 mounted on flexible member 19 and a block 20 of electrical insulating material secured to the lower side of member 19. Block 20 is engaged by keys 9 as the dial 1 rotates and movable contact 18 is caused to move upward and momentarily engage fixed contact 17 each time a key 9 engages block 20.

The center one of the three switches has a fixed contact member 21, a movable contact member 22 mounted on a flexible member 102, and an insulating block 23 mounted on the lower side of member 102. This switch is the same as the switch previously described except that it is operated by key 10 once during each complete rotation of the dial 1. The third switch has a fixed contact member 24, a movable contact member 25 mounted on a flexible member 26 and an insulating block 27 located on the under side of member 26. This switch is also the same as the two switches previously described in construction and operation except that insulating block 27 is longer than the other two insulating blocks and the switch is operated by key 12 located in one of the slots 11 in the inner circle on dial 1.

The electrical circuits to the traffic signal lights are controlled by a drum controller which operates in response to the switch actuations by the keys on dial 1. This drum controller, designated generally by the numeral 28, includes a shaft 29,

a group of discs designated by the numerals 30 to 43 inclusive, and a ratchet wheel 46.

Fig. 2 on the accompanying drawing is a perspective view of the drum 28 illustrating the ratchet wheel 46 at one end of the shaft 29 and the group of discs positioned at equally spaced intervals along the shaft 29. The discs are illustrated in this figure with all their rim sections in place. However, certain selected rim sections are broken off before the drum is installed in the traffic signal controller so that the discs function as cams.

Fig. 3 discloses an end view of one of the discs, for example, disc 42. The disc is made of an insulating material, preferably a molded insulating compound such as a phenolic condensation product with a filler. A number of radial slots divide the rim of the disc into sections. Directly beneath the rim, the disc is reduced in thickness so that any one of the rim sections may be readily broken off. Disc 42 is shown with one such section broken away.

The manner in which disc 42 and the other discs operate the contactors associated with them is also illustrated by Fig. 3. The contactor is mounted on a base 47 of insulating material. A pivot pin 48 having an enlarged head 49 projects from base 47. A contact arm 50, having an opening therein for pin 48, rides on disc 42 and is held firmly against the disc by a spring 51. Movable contact member 52, located on contact arm 50, engages a fixed contact member 53 each time a broken away section of disc 42 passes the upper end of contact arm 50. Electrical connections are made to fixed contact 53 through a terminal 54 on the reverse side of the base. The electrical circuit to movable contact 52 is completed through contact arm 50 which is of electrically conductive material, additional normally closed contacts 55 and 56 and a second terminal 57 on the back of base 47.

For the purpose of rotating the drum 28 in response to switch actuations by the dial keys, a solenoid 58 and a pawl and ratchet mechanism are provided. The pawl and ratchet mechanism comprises a pawl 59 mounted on a crank 60 which, in turn, is pivoted on an armature 61 operated by solenoid 58. When the solenoid is energized, it raises armature 61. When the solenoid is subsequently de-energized, the armature moves downward through the action of gravity due to the weight of the armature 61 and the crank 60. During the upward movement of the armature 61, the pawl 59 slides over the teeth of ratchet wheel 46. When the solenoid is de-energized and armature 61 comes down again, pawl 59 engages a tooth of ratchet wheel 46 and effects a turning movement of drum 28. A spring 62 maintains pawl 59 in contact with ratchet wheel 46 during the upward motion of the plunger.

Fig. 1 on the accompanying drawing includes three conventional traffic signal devices. Two of these have three signal lights each of the conventional colors—red, amber and green—and these lights are designated by R1, A1 and G1 and R2, A2 and G2, respectively. The third signal device has a walk light, which is designated W, in addition to red, amber and green lights, which are designated by R3, A3 and G3.

In the operation of the traffic signal controller of my invention, electrical current is supplied from a local source through a conductor 63, and from a second source S through a conductor 64 which is common to an interconnected group of controllers. The conductor 63 is permanently

connected to a conductor 65 and through a switch 66 to a conductor 67.

Conductor 65, which is permanently energized, provides current for motor field winding 15 through conductor 100 and switch 101. Thus, motor field 15, which is the field that provides for the forward rotation of motor 2, is continuously energized as long as switch 101 remains closed. Conductor 65 also carries current to contact 17. The cooperating contact of this pair is contact 18, which is mounted on spring 19. The lower contact 18 of this pair is lifted into engagement with upper contact 17 by each key 9 as the dial 1 rotates.

The switch comprising contacts 17 and 18 is in a circuit which includes the drum operating solenoid 58. This circuit, which may be called the drum advance circuit, can be traced as follows: source conductor 63, conductor 65, contacts 17 and 18, resilient member 19, conductor 68, contactor 69, conductor 70, conductor 71, switch 72, conductor 73 and through the coil of solenoid 58 to ground potential. Contactor 69, which is controlled by disc 30, is closed for all positions of drum 28 except one. To this end, all but one of the segments of disc 30 are broken away. In the present instance, ratchet wheel 46 has nine teeth, so that the drum has nine positions, in eight of which contactor 69 is in the closed position and in the ninth is in the open position. When contact 18 is moved into engagement with contact 17 by a key 9 at a time when contactor 69 is in the closed position, the operating circuit through coil 58 is closed, thus energizing the solenoid and causing the drum to advance one step when the solenoid is subsequently de-energized. Successive operations of switch 17, 18 by the keys 9 result in a step-by-step movement of the drum 28 at intervals determined by the spacing of keys 9.

If, when contact 18 is moved into engagement with contact 17, contactor 69 is in the open position, the operating circuit through solenoid 58 is not closed and the drum is not advanced. To effect a further movement of the drum under these conditions, there is provided through coil 58 a second circuit which may be termed a local synchronizing circuit or drum release circuit. This circuit, which is in shunt with the drum advance circuit previously described, includes contacts 21 and 22 which are moved into engagement by the action of key 10 on block 23. When, during the rotation of dial 1, key 10 engages block 23 and closes switch 21—22, a circuit is closed through coil 58 as follows: from source conductor 63 through switch 66, conductor 67, switch 74, conductor 84, switch 111 providing solenoid 110 is energized, conductor 44, conductor 108, contacts 21 and 22, conductor 76, conductor 71, switch 72, conductor 73 and through solenoid 58 to ground potential. The closing of this circuit energizes solenoid 58 and causes the drum 28 to be advanced one step, providing solenoid 110, the function of which is explained later, is also energized. It will thus be seen that for each complete rotation of the dial 1 under the conditions described, the drum 28 is rotated one complete revolution in nine successive steps. Of these nine steps, one step, which may be considered the first step, is effected by drum release key 10 and the eight following steps, are effected by the eight drum advance keys 9.

The contactors actuated by discs 33–43 inclusive, control the circuits to the signal lights R1, A1 and G1, R2, A2 and G2, and R3, A3, G3 and W. The discs 33 to 43 inclusive, are arranged in the drum controller with their broken away sections located in such relation to each other that with successive actuations of solenoid 58, first by drum release or local synchronizing key 10 and then by drum advance keys 9, the desired sequence of operation of the signals is effected. The keys 9 and 10 are spaced around the dial 1 to give the desired duration of signals for each drum position. Thus, there is a definite correct relationship between the position of drum 28 and the position of dial 1 which must be maintained for correct operation of the signal lights. This correct relationship is maintained as long as the drum position is in such relationship to the dial position that key 10 operates contacts 21 and 22 at a time when drum disc 30 has moved contactor 69 to the open position. If, for any reason, the traffic signal controller is started into operation with the drum and the dial not in the correct relationship relative to each other, then if it happens that the drum 28 is in the position in which contactor 69 is open, no energization of solenoid 58 will occur and the drum 28 will not move until key 10 actuates contacts 21 and 22, for in this condition keys 9 are ineffective to close the drum advance operating circuit to solenoid 58, since the latter circuit is opened by contactor 69. On the other hand, if the controller is started into operation with the drum and dial not in correct relationship relatively to each other, but at a time when cam 30 is in a position such that contactor 69 is closed, then keys 9 will effect operation of the drum until contactor 69 is opened, after which no further rotation of the drum can occur until key 10 actuates contacts 21 and 22. Thus, it will be seen that if the controller is started in operation when the drum and dial are not in the correct relative relationship, or if at any time during operation of the controller the drum and dial should, for any reason, get out of such correct relative relationship that they will be brought into correct relationship during the first complete rotation of dial 1.

A hand-operated switch or push button station 118 and two conductors 119 are connected directly to the source of local power and to one terminal of switch 72 to provide for manual operation of drum 28. Switch 118 and conductors 119 by-pass the drum advance and drum release circuits associated with dial 1 and permit the operation of solenoid 58 directly from the local power source by manually depressing switch 118.

The second source of power S is used for synchronizing a group of interconnected controllers with each other and with a master controller designated by the numeral 77. The master controller 77 is diagrammatically illustrated as being provided with a cam 78 which periodically opens a switch 79. The switch 79 is connected in a circuit which includes contacts 24 and 25 and the field winding 16 of motor 2. This circuit may be traced as follows: source S, switch 79, conductor 64, conductor 80, flexible arm 26, contacts 25 and 24, conductor 81 through winding 16 to ground potential. Switch 79 is normally closed and is opened periodically once during each complete rotation of cam 78. Contacts 24 and 25 are normally open and are closed once during each complete revolution of dial 1 by key 12 engaging block 27. During cyclic operation, if the controller at an intersection is in synchronism with the master controller, the timing is such that key 12 effects a closing of contacts 24 and

25 at the instant that cam 78 effects an opening of switch 79, with the result that the circuit through winding 16 of motor 2 is not completed. If, however, when key 12 effects a closing of contacts 25 and 24, cam 78 is in a position such that switch 79 is closed, indicating that the intersection controller is not in the correct time relationship with the master controller, the circuit through field winding 16 is completed and motor 2 is stopped, due to the field 16 opposing field 15. When the motor is thus stopped, contacts 24 and 25 are held closed by key 12, and the circuit which has been established through field winding 16 remains closed until cam 78 has moved to a position which permits switch 79 to open whereupon motor 2 will again start operating and move key 12 to permit contacts 24 and 25 to open. When this occurs, dial 1 is in the correct synchronous relation to the master controller.

Each controller of a group being similarly equipped will actuate a similar pair of contacts at an instant during its operating cycle. If the controller is in synchronism with the remainder of the system, it will continue to operate. If it is not in synchronism, it will stop and will start again at the time switch 79 is opened. The positioning of key 12 in slots 11, therefore, determines the relationship in which the controller and the signals operated thereby will be maintained in relationship to other controllers in the system.

The drum 28 in the present controller is provided with fourteen discs, of which disc 30 regulates the position of the drum relative to the dial 1. Discs 31 and 32 perform functions which are described in detail later. Discs 33–43 inclusive, control the red, amber, green and walk signal lights. In this particular instance, provision is made for red, amber, and green signal lights for the control of vehicular traffic in two intersecting main streets and a cross street, with a walk light on the traffic signal device for the latter street which provides for pedestrian crossing of the two main streets. It should be understood, however, that my invention is applicable in any traffic signal controller in which provision for pedestrian actuation is desired.

As stated above, the contacts operated by each disc on the drum controller are normally open but are closed in one or more positions of the drum, dependent upon the signalling cycle. The electrical current for the steady operation of all signal lights is received from the local source through a circuit made up of conductor 63, switch 66, conductor 67, switch 74, conductor 24, conductor 85, switch 86 providing solenoid 104 is energized, conductor 87 and conductor 107. A common electrical bus 107', best seen in Fig. 3, joins one terminal each of contactors 33–42 inclusive, so that all receive current from a single source. The contactor associated with disc 43 receives current through a separate circuit which is described later. When the discs 33–42 inclusive, are in the proper position, the contactors corresponding to the broken out rim sections of the various discs are closed, and the desired combination of signal lights is energized through an interconnecting cable 66.

The push-pull switch 74 is provided to open and close the steady current energization circuit of the traffic signal lights just described. In addition, switch 74 controls a flashing mechanism which makes it possible to operate a portion of the signal lights as periodically flashing signals. This type of operation is preferably used during periods of light traffic and the amber lights are usually chosen for the flashing signals. In the position shown in Fig. 1, switch 74 is in a position to connect the amber signal lights A1, A2 and A3 to the contactors of the drum controller so that these signals are under the control of discs 34, 37 and 40, respectively. When the switch 74 is thrown to its second position, the conductor 67, which supplies the local current for operating the signal lights, is separated from conductor 84 and no current flows to the drum contactors through conductor 84. Simultaneously, signal lights A1, A2 and A3 are connected to a flashing mechanism by conductor 89.

The flashing mechanism comprises a stationary contact 91 mounted on a fixed support (not shown) and a movable contact 92 mounted on a contact arm 93 which is, in turn, secured at one end on a fixed support 94. The arm 93 is pivoted at one end on support 94 and is bent at right angles at the opposite end to provide a nose portion 95. The end of nose 95 rides on the periphery of star wheel 7 and the rotation of the star wheel causes an intermittent engagement of contacts 91 and 92. Contact 91 is connected to supply conductor 67 by a conductor 96 and contact arm 93 is connected to conductor 89.

In operation, when switch 74 is thrown to its second position it shuts off the supply of electrical current to the red, amber, green and walk signal lights through conductor 84 and transfers the amber signal lights to the local current supply through the flashing mechanism. Simultaneously, switch 74 causes a solenoid 83 to be energized from the local source of electrical energy through conductor 67, switch 74, and conductor 115, thence through solenoid 83 to ground potential, the effect of energizing this solenoid being to open switch 93 and thus disconnect the balance of the controller circuits from the flashing mechanism. Under these conditions, as star wheel 7 rotates, it operates contacts 91 and 92 to intermittently energize the amber signal lights. The movement of switch 74 to the second position also disconnects conductor 84 and the balance of the resynchronizing or drum release circuit from the local current supply, thus preventing the operation of the local synchronizing circuit. After this circuit has been opened, drum 28 will continue to be advanced step-by-step by keys 9 operating switch 17, 18 until it reaches the position at which disc 30 opens the drum advance circuit. The drum will then remain in that position until switch 74 is again thrown to its first position.

Inasmuch as continued cyclic operation of the controller requires switch 111, which is actuated by a solenoid 110, to be closed in order to complete the drum release circuit at the beginning of each signal cycle, the controller will not function with continuous cycling operation unless solenoid 110 is energized. It is by means of this arrangement that provision is made for pedestrian actuation. In this controller, the solenoid 110 is deenergized in the absence of pedestrian actuation so that switch 111 is normally open. Under these conditions, therefore, drum 28 comes to a halt when the end of a cycle is reached because switch 111 opens the drum release circuit and does not permit the drum release circuit to move the drum the one additional step necessary to begin another cycle.

As mentioned previously, the signal cycle of this controller has nine intervals; that is, there are nine different combinations of signal lights which correspond to the nine steps of drum con-

troller 28. It should be understood, however, that my invention is not limited to a traffic signal controller having a nine interval signal cycle but can be used on controllers having more or less than this number of intervals. The nine intervals of this controller are shown in detail in the tabulation of Fig. 4 of the accompanying drawing, including the sequence of signal light combinations and the arrangement of discs which produces this sequence. When this controller is arranged for pedestrian actuation, the drum comes to rest at interval or position 4 and both main street signals show flashing amber while the cross street signal shows flashing red. The controller remains in this position and the signals flash continuously until there is a pedestrian actuation. The operation of the traffic signal controller following a pedestrian actuation is explained subsequently.

If it is desired to transfer the traffic signal controller to conventional cyclic operation in synchronism with other controllers in an interconnected system, it is necessary only to close switch 103. Closing switch 103 energizes solenoid 104 from the local supply source through a circuit composed of switch 66, conductor 67, switch 74, conductor 84, conductor 85, switch 103 and through the coil of solenoid 104 to ground potential. The operation of solenoid 104 raises switches 86 and 105 to their upper positions and by means of the latter switch closes a by-pass around switch 111 in the drum release circuit. When switch 105 is in the upper position, a by-pass circuit around switch 111 is completed from the local source through the route just described to switch 103, thence through switch 105, conductor 106, and conductor 108 to the drum release contacts 21 and 22. When the drum release circuit is completed in this manner, the drum 28 begins to rotate the next time during the rotation of dial 1 that contacts 21 and 22 are closed by key 10 and thereafter operates continuously in synchronism with dial 1 and with other interconnected controllers as long as switch 103 is closed and solenoid 104 is energized.

Assuming now that switch 103 is open and drum 28 is stationary at position 4 with amber lights A1 and A2 and red light R3 flashing, it is possible for a pedestrian to actuate the controller to cause it to make a complete nine interval cycle. Such a cycle includes one interval, Number 6, in which red signal lights are energized to stop vehicular traffic on the main streets and a walk light is energized which permits the pedestrian to cross those streets.

Such a pedestrian operation of the controller is initiated by depressing a push button 109, which may be located at any convenient point near the intersection. This completes a circuit which energizes solenoid 110 and raises switches 111 and 112 to the upper positions. When push button station 109 is depressed, solenoid 110 is energized by a circuit completed from the local source through switch 66, conductor 67, switch 74, conductor 84, conductor 113, contactor 75, conductor 114, push button 109 and through the coil of solenoid 110 to ground potential. It can be seen from Fig. 4 that contactor 75, which is operated by disc 31, is closed at position 4 of the drum controller which makes possible the completion of this circuit when the drum is at position 4. When switch 112 is thus raised to the upper position, a hold-in circuit for solenoid 110 is completed from conductor 114 through conductor 115 and switch 112 which is effective as

long as contactor 75 remains closed. Simultaneously, the drum release circuit is completed by the closing of switch 111. The drum release circuit does not function immediately that a pedestrian actuates push button 109, but as soon as contacts 21 and 22 are closed by key 10, the drum controller makes one complete revolution, thus causing the signal lights to go through one complete nine interval cycle. The drum controller does not continue to rotate, however, unless there are one or more additional operations of push button 109 during the first cycle because the drum release circuit is again opened by the opening of contactor 75 by disc 31 at interval 6 of the cycle.

It is readily apparent from the foregoing description that solenoid 110 and its associated switches 111 and 112, which collectively may be called a memory device, are effective to retain a pedestrian signal until the proper point is reached by timing dial 1 and then cause drum 28 to make one revolution to produce one complete cycle of traffic signals. This single cycle of signals is coordinated with other traffic signal controllers in an interconnected system so that the walk signal, which is included in the signal sequence of this controller, is given only when vehicular traffic is at a minimum through the action of all controllers in the system.

Solenoid 104 and its associated switches 86 and 105, which collectively may be called a transfer device in view of their function of transferring the controller from pedestrian actuation to continuous cyclic operation when actuated by switch 103, also have other important functions. Solenoid 104 is not energized at position 4 of drum controller 28 during pedestrian actuated operation but is energized at all positions except position 4. This energization occurs through a circuit composed of switch 66, conductor 67, push-pull switch 74, conductor 84, conductor 113, contactor 82, and conductor 117. As indicated in Fig. 4, switch 82, which is operated by disc 32, is closed at all positions of the drum controller except position 4; therefore, solenoid 104 is energized at all positions except Number 4 during pedestrian actuated operation.

When the drum is at position 4 and solenoid 104 is not energized, it is a function of the transfer device, and more specifically of switch 86, to provide connections to the flashing mechanism to obtain an intermittent source of current for the flashing operation of amber lights A1 and A2 and red light R3 at this position of the drum. Under this condition, switch 86 receives intermittent energy from the flashing mechanism through conductor 89, conductor 97, switch 98, and conductor 99. When switch 86 is in the lower position, this intermittent energy is transmitted to bus 107' of the drum controller through conductor 107. The contactors corresponding to discs 34, 37 and 39 are closed when the drum is in position 4; therefore, the signal circuits corresponding to these three discs, which are, respectively, A1, A2 and R3, are closed, and flashing operation of these three signals is provided.

In this connection, it will be understood that when the controller is operating as a conventional continuous cyclic controller in the manner described previously, as a result of the closing of switch 103, that the signals do not flash during interval 4 because solenoid 104 does not become deenergized during this interval to permit switch 86 to close. During such continuous

cyclic operation lights A1, A2 and R3 provide a steady signal during interval 4.

When solenoid 104 is energized, as is the case for all positions of the drum controller except position 4 during pedestrian actuated operation, switch 86 is in the upper position and bus 107' is disconnected from the flashing mechanism. Bus 107' is then supplied with current for steady operation of the signal lights directly from the local source through the circuit previously described, including conductor 85, conductor 87, and conductor 107.

A conductor 120 is connected directly to conductor 99 at one terminal of switch 86. Through conductor 120, the contactor associated with disc 43 on the drum controller is supplied with intermittent energy at all positions of the drum as long as solenoid 83 is not energized and switch 98 remains closed. At positions 7 and 8 of the drum, as indicated in Fig. 4, the contactor of disc 43 is closed. Thus, walk light W is energized to produce a flashing walk signal at these two positions through a conductor 121, which is connected to the walk light signal circuit emanating from disc 42. It will be understood that walk light W flashes during intervals 7 and 8 for both continuous cyclic operation and pedestrian actuated intermittent cyclic operation.

It will be understood from the foregoing description that a traffic signal controller is provided having four basic operating positions. One is for manual operation. A second is for use during periods of light traffic, and provides for the continuous flashing of amber lights (and/or other lights if desired) in the conventional manner. The timing, cycling and synchronizing mechanisms are completely disabled during the time the controller is in the second position, as well as in the first position. The third position provides for conventional continuous cyclic operation in synchronism with other controllers in an interconnected system. The fourth position provides for pedestrian actuation. Flashing signals are produced during certain operating intervals while the controller is in either of the last two positions, but these intervals are not to be confused with the second position when there is continuous flashing without cyclic operation of either the intermittent or continuous type.

While I have illustrated and described one preferred embodiment of my invention, many modifications will occur to those skilled in the art and, therefore, it should be understood that I intend to cover, by the appended claims, all such modifications as fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A traffic signal timer comprising a rotatable drum controller, a group of contactors for traffic signal circuits operated by said drum controller, a dial, means for rotating said dial continuously, means for continuously effecting step by step cyclic rotation of said drum controller in response to the rotation of said dial, means including a manually actuated device for initiating a single step by step revolution of said drum controller in response to the rotation of said dial, means for transferring from continuous to such manually actuated operation of said drum controller, means associated with said transfer means for normally holding said drum controller stationary at a predetermined position when a transfer to manually actuated operation occurs, means for effecting the return of said drum controller to said predetermined position at the conclusion of each cycle of manually operated operation thereof whereby upon a return to continuous operation a selected combination of signals will first be shown, and means for maintaining synchronism between said dial and said drum controller during continuous and manually operated operations of said drum controller.

2. In a traffic signal controller for an intersection of a plurality of streets having a pedestrain crossing, a continuously rotating dial having a plurality of spaced openings in circles concentric to its axis of rotation, a plurality of keys in selected openings in said dial, a plurality of circuit closers operated by said keys, a group of contacts for controlling traffic signals, a rotatable drum controller for operating said contacts, means for operating said drum controller responsively to the continuous movement of said dial, means for maintaining synchronism between said drum and said dial comprising a synchronizing circuit including one of said circuit closers and a switch opened by said drum when the latter is in a position to energize selected signals to said intersecting streets, means actuated by said dial and one of said circuit closers to close a second circuit in shunt to said drum operated switch when said dial reaches a predetermined position, selective means for preventing the completion of said second circuit whereby said drum is caused to stop in said selected position, and manually actuated means for disabling said preventing means for an interval less than that required for a complete revolution of said dial whereby said drum is caused to make a complete revolution starting from said selected position.

3. A pedestrian actuated traffic signal controller comprising a dial, a synchronous motor for rotating said dial, a plurality of spaced actuating keys carried by said dial and arranged to move in a plurality of annular paths as the dial rotates, a plurality of switches comprising fixed and movable contacts, said switches being positioned adjacent said annular paths whereby said actuating keys periodically come in contact with said movable contacts and close said switches momentarily at regularly recurring intervals during the rotation of said dial, electrical conductors for connecting the traffic controller to a source of electrical energy, means for converting a portion of the electrical energy used by the controller to intermittent energy, said means comprising a star wheel driven by said motor and a switch operable by said star wheel which is intermittently opened and closed as said star wheel rotates, a plurality of contactors for operating traffic signal lights continuously and intermittently during selected intervals, a contactor operating drum having a plurality of cams associated with said contactors, means for imparting step by step turning movement to said drum comprising a ratchet wheel connected thereto and a solenoid-operated pawl engaging the teeth on said ratchet wheel, electrical connections between said key actuated switches and the solenoid on said pawl whereby the action of said keys on said switches causes the contact operating drum to rotate step by step when said connections are energized, selective means whereby said drum is caused to operate in continuous step by step rotation, selective means for causing said drum to remain in a predeter-

mined position in the absence of a signal voltage, and manually actuated means providing said signal voltage for temporarily disabling said last named selective means and causing said drum to make one complete revolution.

4. In a traffic signal controller for an intersection of two major roads and one relatively minor road having at least one pedestrian crossing, a circular dial, a synchronous motor for rotating said dial at a constant speed, a plurality of spaced openings in said dial in two circles concentric to the axis of rotation thereof, a plurality of keys in selected openings in said dial including at least one key in the inner of said concentric circles and one key longer than the others in the outer of said concentric circles, a plurality of circuit closing switches operated at regularly recurring intervals by said keys as they rotate, a plurality of signal light energizing switches, a rotatable drum controller comprising a plurality of cams for operating said signal light switches, means including a solenoid operated ratchet and pawl mechanism for operating said drum controller in step-by-step rotation responsively to the rotation of said dial, means for maintaining said dial and said drum in the correct relative relationship to each other during rotation of said drum comprising a synchronizing circuit including one of said circuit closing switches and a drum interlock switch opened by one of said cams when said drum reaches a selected position, means actuated by said dial and a second one of said circuit closing switches for closing a second circuit in shunt to said drum interlock switch when said dial reaches a predetermined position, transfer means including a solenoid operated switch for selectively preventing the completion of said second circuit, means including a push button station for receiving a pedestrian signal, a memory device for retaining said signal until said dial reaches said correct relative relationship to said drum, and means whereby said drum, following a pedestrian signal, is caused to make one complete revolution starting at said point where drum and dial are in correct relationship.

5. A traffic signal controller comprising a plurality of signal circuit contacts, a rotatable cam drum for actuating said contacts, a rotatable dial, means for continuously rotating said dial, first drum advancing means controlled by said dial for intermittently rotating said drum in response to continuous rotation of said dial, means controlled by said drum for normally disabling said first drum advancing means in a predetermined position of said drum, and additional means for advancing said drum from said predetermined position including manually operable means and means rendering said manually operable means effective only at a predetermined position of said dial.

6. A traffic signal controller comprising a plurality of signal circuit contacts, a rotatable cam drum for actuating said contacts, a rotatable dial, means for continuously rotating said dial, first drum advancing means controlled by said dial for intermittently rotating said drum in response to such continuous rotation of said dial, means controlled by said drum for normally disabling said first drum advancing means in a predetermined drum position, second drum advancing means controlled by said dial and effective only in a single predetermined dial position for advancing said drum from said predetermined drum position, and manually operable means for initiating operation of said second drum advancing means.

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