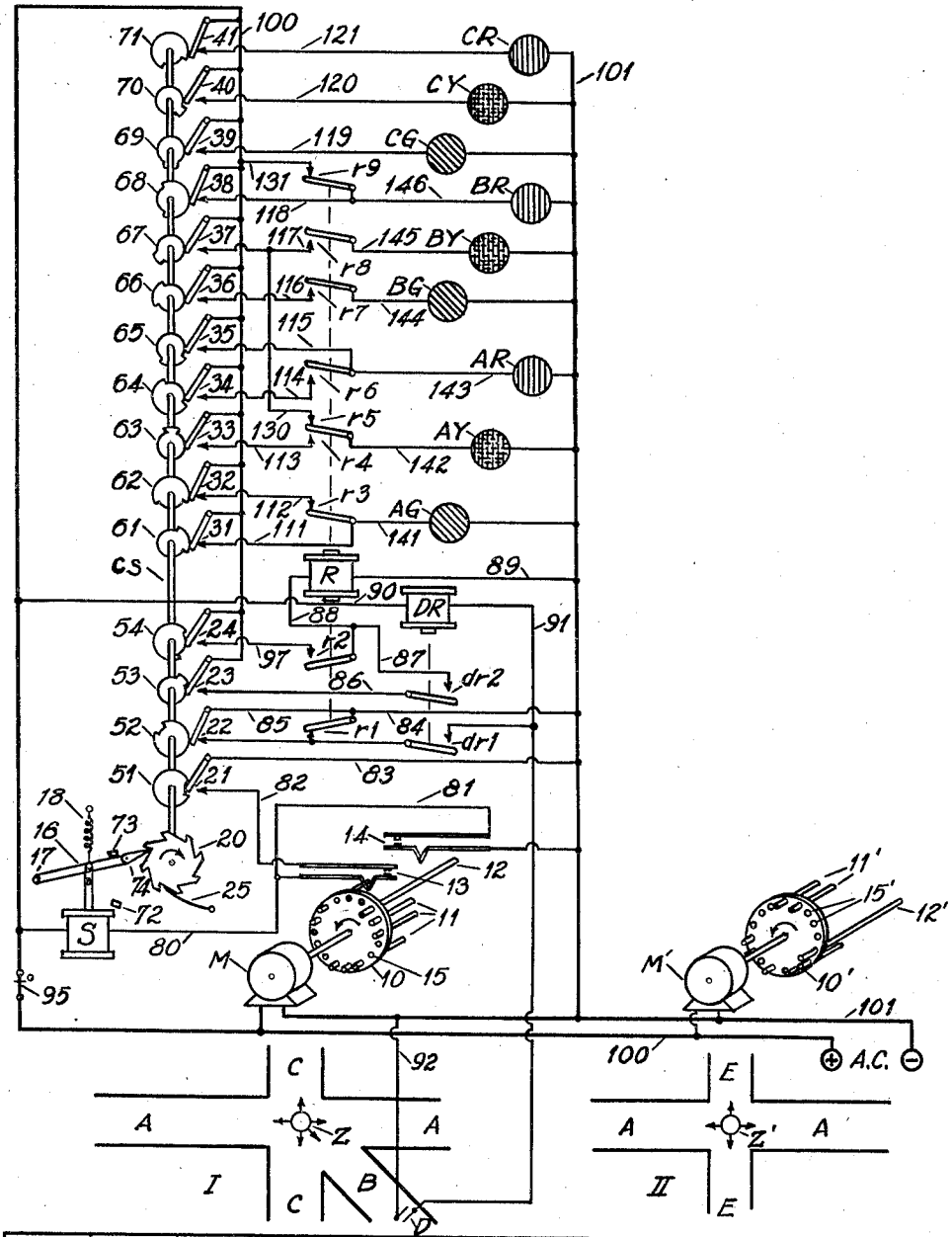
May 5, 1942. J. L. BARKER 2,282,142

TRAFFIC ACTUATED SIGNALING APPARATUS

Filed Aug. 8, 1940



CAM POSITION	SIGNAL PERIOD	CAM CONTACTS CLOSED														
		21	22	23	24	31	32	33	34	35	36	37	38	39	40	41
1	AG1		X			X	X						X			X
2	AG2	X	X	X	X	X	X						X			X
3	AY	X	X		X		X	X					X			X
4	BG1	X			X		X		X		X					X
5	BG2	X	X		X		X		X		X					X
6	BY	X	X		X				X			X				X
7	CG	X	X		X				X	X			X	X		
8	CY	X	X						X	X			X		X	

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TRAFFIC ACTUATED SIGNALING APPARATUS

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13 Claims. (Cl. 177—337)

The present invention relates generally to traffic control apparatus of the traffic actuated type employed for the control of right of way of traffic at intersections of streets or roads, and in which a traffic signal is controlled through a time cycle by a timing mechanism or "controller" in accordance with traffic actuations of traffic detectors in one or more roads entering the intersection.

The invention relates more particularly to improved traffic signal control apparatus of the traffic actuated type for use at one or more intersections of three roads in which one of the roads at the intersection has relatively little traffic compared with the other two roads but interferes sufficiently with traffic on such other roads to require a separate right of way period in the traffic signal time cycle.

The invention is also of particular value at one or more of a series of intersections at which the timing of traffic signals is coordinated to permit progressive movement of traffic along a main road through the several intersections for example, or to provide for simultaneous movement of main road traffic at all of the series of intersections as an alternative example.

In such coordinated systems the total time length of the signaling cycle must ordinarily be the same at the several intersections, and at certain intersections having a lightly travelled third road it may be desirable to have the signal normally operated to accord right of way alternately to the two major intersecting roads for appropriate divisions of the total cycle and to maintain right of way interrupted on the third road in the absence of traffic in the latter road, but to include in an appropriate part of the same total cycle a right of way period for the third road in event of arrival of traffic on the third road.

One type of periodic traffic signal controller in the prior art employs a signal switching camshaft of the step-by-step type and a solenoid operated ratcheting device for stepping the camshaft through its signal cycle, the solenoid being operated momentarily from time to time over an operating circuit including contacts operated at desired time intervals by one or more correlated timing devices. In one form of such controller the timing device comprises a dial rotated continuously by a synchronous motor and bearing pins placed at desired spacing around the dial to operate the solenoid contacts at appropriate time intervals. In such type of controller one revolution of the dial determines the total time length of the signal cycle and the pins are placed in desired positions in the rotating dial so as to divide the total cycle for the several steps of the camshaft.

In using such controllers in a coordinated system the dials at the several intersections are maintained in predetermined time relation in some systems by their respective synchronous driving motors and in other systems by auxiliary means connected with a master controller to resynchronize each dial with the master controller once per cycle.

In the present embodiment the invention is illustrated in a traffic signal controller of the synchronous motor driven continuously rotating dial type. In accordance with the invention switches controlled by the third street traffic detector are interposed in the signal control circuits extending between the traffic signals and the step-by-step camshaft switches, so that in absence of traffic actuation of the detector the signal circuits will be completed to certain cam switches to provide alternate right of way signal periods for two of the three roads but in response to traffic actuation of the detector the signal circuits will be completed to certain other cam switches to include a right of way signal period for the third road in place of a part of the right of way signal period for one of the other two roads.

It is a general object of the invention to provide improved traffic signaling apparatus for including an additional right of way signaling period, responsive to traffic actuation, in a predetermined part of a signaling cycle normally providing a predetermined plurality of right of way signaling periods in absence of such traffic actuation.

It is a further object of the invention to provide improved traffic signaling apparatus for an intersection of three roads to include a third right of way signaling period for the third road, responsive to traffic in the third road, in a predetermined part of a signaling cycle normally providing two alternate right of way signaling periods for the other two roads in absence of traffic on the third road.

It is also an object of the invention to provide improved traffic signaling apparatus for one or more of a group of coordinated traffic signals to include an additional right of way signaling period, responsive to traffic actuation, in a signaling cycle normally providing a predetermined plurality of right of way signaling periods in absence of traffic actuation, and to provide such

additional right of way period in a part of the same total time cycle in predetermined time relation with the right of way signaling cycle at one or more of the other intersections of such coordinated group.

It is an additional object of the invention to provide improved traffic signaling apparatus for including a third right of way signaling period, responsive to traffic actuation, in a signaling cycle normally providing two alternate right of way signaling periods, in which the right of way signaling cycles are provided by signaling circuits controlled by camshaft switches and in which additional switches controlled by traffic actuation are interposed in certain of such signaling circuits to select between two sets of cam switches for including and excluding such third right of way period alternatively.

Other objects may appear in the further disclosure and claims herein.

Apparatus embodying the invention will now be described and its operation explained in connection with the accompanying drawing.

On the left side of the drawing is represented the intersection I of a main road A, a major cross road C and a minor cross road B, with a traffic signal Z in the intersection and a traffic detector D in the B road. The usual red, yellow and green colored signal lights CR, CY, CG for C road, BR, BY, BG for B road and AR, AY, AG for A road are provided at Z for these roads respectively to indicate when traffic is to stop or go or to expect a change of right of way. These several signal lights, or signals as they are ordinarily referred to, are arranged to face the several roads as indicated by the arrows on the signal assembly Z and the several signal lights are also shown schematically in their respective circuits in the upper part of the drawing.

It will be appreciated that the several signal lights may be arranged at convenient points around the intersection instead of in or over the center of the intersection as shown at Z.

Above the intersection I and extending to the top of the drawing is illustrated a timing mechanism or controller of the rotating dial type for the traffic signal Z, with dial 10 rotated by the synchronous motor M.

By means of pins or studs in the rotating disc and a linking arrangement shown herein to be comprised of contacts adapted to be actuated by the pins to energize the solenoid S of a solenoid-operated ratcheting mechanism, a camshaft CS is operated step-by-step through a cycle of operation. Contacts operated by cams on the shaft control the display of signal indications.

The dial rotates continuously and the several pins operate contacts 13 or 14 to step the camshaft CS through the several cam positions, to operate the several cam contacts 31 through 41 for the signal circuits as well as the auxiliary control circuit cam contacts 21 through 24. A series of contacts or switches r1 through r9 are interposed between the signals of A and B roads and their cam contacts, and are controlled by relay coil R which in turn is controlled by cam contacts 23 and 24 and by relay DR which in turn is controlled by detector D in the B road.

Sufficient cams and contacts are employed to provide both the two right of way period signal cycle and the three right of way period signal cycle, the A right of way period in the two period cycle being divided into A and B right of way periods in the three period cycle.

When traffic detector D is actuated the relay DR is operated and during the next signal cycle relay R is operated to switch the A and B signal circuits from the two period cycle cam contacts to the three period cycle cam contacts, as will be more fully explained subsequently in this specification.

At the right side of the drawing another intersection II along the main road A is illustrated at a cross road E, and has a signal Z' which provides also the normal red, yellow and green colored signal lights displayed to A road and E road as indicated by the arrows.

Above the intersection II is shown in the drawing the motor M' and dial 10' of a controller for the traffic signal Z'. This controller is preferably of a type similar to the controller of intersection I except that the controller for II requires only six signal cams and switches for six signals AR, AY, AG, ER, EY and EG for the main and cross road signals and the solenoid control cam switch 21, and the traffic actuated relays R and DR and detector D are omitted as it is assumed that the intersection II is of the non-actuated or "fixed time" type.

The motors M and M' for the two intersections are preferably of the self-starting synchronous type connected to the same alternating current power supply AC to maintain the respective controller dials 10 and 10' in predetermined cyclic relation for progressive traffic movement along the main road A. Any other controllers of either type at other intersections in the coordinated system would be connected to the same AC power supply.

The construction and operation of an embodiment of the invention in a controller of the rotating dial type will now be described in more detail.

The traffic detector D, in the minor cross road B, is illustrated schematically as a pair of contacts which are adapted to close a circuit between wires 91 and 92 responsive to passage of a vehicle over the detectors for example. Various forms of such traffic detectors are well known in the art such as the pressure contact type in which pressure of the vehicle wheel operates the contacts, the magnetic type in which disturbance of a magnetic field by a passing vehicle generates a small electric voltage to operate relay contacts, the photo-electric type in which interruption of a light beam affects a photo-electric cell to operate relay contacts, and the sound type in which the sound of passing vehicles is detected by a microphone or other sound pickup device to operate a pair of contacts, for example. It is also well known to use pedestrian push buttons to close the detector circuit 91—92 as well as a vehicle detector. In each case the relay contacts may be operated directly or through an amplifier as needed or desired.

The vehicle detector D is ordinarily located in the side of the road to be actuated only by vehicles approaching the intersection in road B.

The controller at intersection I for example is of the rotating dial or disc type and includes a self-starting synchronous type motor M, which may be of the general type well known for synchronous electric clocks, for example. The motor M is connected to leads from an AC power source, which is common to all the controllers forming part of the system, for driving continuously a disc 10 either directly or by a system of gearing. A plurality of pins or studs 11 are removably mounted in the face of disc 10 and co-

operate with a pair of contacts 13 to close a circuit through the contacts, and another pin 12 also removably mounted in the face of the disc but longer than and independent of pins 11 cooperates in similar fashion with the contact pin 14.

The disc is preferably provided with a series of holes 15 near its periphery and the pins may be fitted into selected holes as desired to determine the division of the fixed total time cycle into appropriate signal periods by stepping the camshaft CS by actuation of the solenoid S. The camshaft CS has an appropriate matching arrangement of cams to provide the several different signal combinations and the distribution of pins in the continuously rotating disc determines the periods of display of these several combinations, when the solenoid is connected to be actuated by the pin operated contacts.

The camshaft CS is carried in suitable bearings and has mounted on it a plurality of cams 61—71 for operating signal energizing contacts and cams 51—54 for operating control circuits. A solenoid S is arranged to advance the camshaft step-by-step through its cycle by means of a ratchet 20 on the camshaft and a pawl 74, energization and deenergization of the solenoid moving the camshaft one step. Energizing the solenoid causes the pawl arm 16, pivoted at 17, to be pulled down against stop 72 against tension in spring 18, causing the pawl 74 to engage another tooth on ratchet 20 which is prevented from moving backwards by dead pawl 25. Subsequent deenergization of solenoid S allows spring 18 to contract and return arm 16 against stop 73 thus advancing the camshaft counter clockwise one step or tooth in ratchet 20.

Two circuits are provided for energizing the solenoid S. One of these circuits includes the pair of contacts 13 which are adapted momentarily to be closed by each of the pins 11 in succession as each one of the pins 11 is rotated through the top of its circular path of movement. The other circuit includes contact pair 14 which is closed once in each cycle of the disc by the synchronizing pin 12 the purpose of which will subsequently appear.

The disclosed embodiment of the controller shows an 8 position camshaft and accordingly there are provided 7 pins 11 for energizing the solenoid to step the camshaft through all but one of its positions from which one position only the pin 12 and its cooperating contact pair 14 are effective to advance the camshaft. Obviously if more camshaft positions are desired a greater number of pins 11 are inserted in disc 10 keeping the number of pins 11 always one less than the total number of camshaft positions, and corresponding teeth on ratchet 20.

A chart of camshaft positions is included in the lower left portion of the drawing and indicates by means of an X in a square that the contacts 21—24 and 31—41 are closed in a particular camshaft position.

In series with contacts 13 is a pair of contacts 21 which are closed by cam 51 in all positions of the camshaft except position 1, which is termed first A Green position AG1, in which pins 11 and contacts 13 are rendered ineffective to advance the camshaft by the opening of contacts 21 as shown in the drawing.

In position 1 only contacts 14 are effective to close the solenoid S circuit and contacts 14 are in position to be operated only by the long pin 12, so that the camshaft CS can be advanced from position 1 only by the long pin 12 operating contacts 14, and this provides a means for resynchronizing the camshaft CS with the dial 10 once per cycle.

In all positions of the shaft except position 1 however, a circuit is completed to energize solenoid S upon the momentary closure of contacts 13 by one of the pins 11 from AC minus over wire 83, contacts 21, wire 82, contacts 13, and wire 80, and upon the immediate opening of contacts 13 to deenergize solenoid S and advance the camshaft one tooth or position.

Let us now consider a cycle of operation of the dial and camshaft in the absence of traffic on road B. Under this assumed condition the operation of cam contacts 22 through 24 for the control circuits will have no significance, and the significance of the cam contact 21 in connection with contacts 13 has already been explained so that operation only of the cam contacts 31 through 41 for the signal circuits will be considered in this cycle of operation.

Let it be assumed to start that the camshaft is in position 1, signal period AG1, in which contacts 31, 32, 38 and 41 are closed by cams 61, 62, 68 and 71 respectively. Contacts 31 energize the A road green signal AG from AC plus power wire 100 via wires 111 and 141, signal AG to AC minus power wire 101. Contacts 38 energize the B road red signal BR from plus wire 100 via wires 118 and 146 to minus wire 101. Contacts 41 energize the C road red signal CR via wire 121 between the plus and minus power wires.

The closed condition of cam contacts 32 in position 1 has no immediate significance.

As disclosed above contacts 13 are ineffective to energize solenoid S in position 1 because cam contacts 21 are open but contacts 14 are operated by the synchronizing pin 12 at the end of period AG1 to energize solenoid S momentarily via wires 80 and 81 to advance camshaft CS to position 2. The time the camshaft remains in position 1 depends on the predetermined constant speed of the dial 10 and the preselected spacing of the pins 11 and 12.

By reference to the cam chart it will be noted that in the AG2 position 2 the contacts 31, 32, 38 and 41 remain closed as in position 1 so there is no change in signal display.

As dial 10 rotates, the next pin 11 closes contacts 13 to operate solenoid S momentarly to advance camshaft CS to position 3. In this AY signal position the cam contacts 31 have opened, but under the assumed condition of absence of traffic actuation the relay contacts $r3$ will be closed and the AG signal will be maintained energized via relay contacts $r3$ and cam contact 32 which remains closed in this position. The contacts 38 and 41 remain energized in position 3 as in position 2, continuing display of signals BR and CR.

In position 3 cam contacts 33 are closed but the A yellow signal AY is not energized thereby because relay contacts $r4$ are open. Signal AY is connected via closed relay contacts $r5$ to wire 117 and cam contacts 37 but these contacts are open and thus signal AY remains deenergized.

Another pin 11 next operates contacts 13 to actuate solenoid S and advance the camshaft to position 4.

In position 4, cam contacts 32 remain closed and the signal AG remains energized over these contacts via relay contacts $r3$. Cam contacts 33 have now opened but since relay contacts $r9$ re-

main closed in absence of traffic actuation, the B road red signal BR remains energized over these contacts connected directly to plus power. Cam contacts 33 have now opened again but have no effect as described above.

Also in position 4 the cam contacts 34 and 36 become closed but these are not effective to change the signal display since they are disconnected from the signals by the open relay contacts *r*6 and *r*7 respectively.

As soon as the dial 10 has turned sufficiently for the next pin 11 to close contacts 13 momentarily solenoid S is operated to advance camshaft CS into position 5. In this position the signal cam contacts remain the same as in position 4.

As soon as another pin 11 operates contacts 13 the solenoid advances the camshaft to position 6. In this position cam contacts 32 open and thus deenergize the A green signal AG, since cam contacts are already open. In position 6 the cam contacts 37 close and energize the A yellow signal AY via wire 130, relay contacts *r*5 and wire 142.

When dial 10 has turned far enough for the next pin 11 to close contacts 13 momentarily again the solenoid is again operated and advances the cam shaft to position 7. In this position cam contacts 35 close and energize the A red signal AR via wire 115 and wire 143. Cam contacts 33 also close to energize the B red signal BR over wires 118 and 146 but this signal is already energized over wire 131, relay contacts *r*8 and wire 146 so that the closure of cam contacts 38 has no immediate effect. Cam contacts 39 close to energize the C green signal CG over wire 119. Cam contacts 41 open in position 7 so as to deenergize the C red signal CR at wire 121.

As soon as the next pin 11 operates contacts 13 as a result of further rotation of the dial 10, the solenoid is operated again to advance the cam shaft to position 8. In this position cam contacts 35 remain closed to maintain the A red signal AR energized. Cam contacts 39 are now open to deenergize the C green signal CG. Cam contacts 40 are closed to energize the C yellow signal CY over wire 120.

The next pin 11 to be operated by rotation of dial 10 operates contacts 13 again for the solenoid to advance the cam shaft to position 1. In this position cam contacts 31 and 32 close, both energizing the A green signal AG, and cam contacts 41 also close to energize signal CR. Cam contacts 34 and 35 both open so as to deenergize signal AR and cam contacts 40 also open to deenergize signal CY.

The cam shaft has now returned to the original position from which the description of the cycle of operation was started, under the assumption that no traffic actuation of detector D had occurred.

A cycle of operations will now be considered under the assumption that a traffic actuation of detector D in road B has occurred. Actuation of detector D closes the contacts of this detector and thus energizes relay DR over a circuit from AC minus wire 101 via wire 92, detector D, wire 91, relay DR and wire 90 to AC plus wire 100. It will be assumed for example that the detector actuation occurred in cam shaft position 1. Relay DR will be electrically locked in its energized position by its contact *dr*1 over a circuit from AC minus wire 101 via wire 84, wire 85, cam contacts 22, relay contacts *dr*1, wire 91, relay DR, wire 90 to AC plus. This locking circuit also includes contacts *r*1 of relay R in parallel with cam contacts 22.

Since cam contacts 21 are open in cam shaft position 1 contacts 13 are ineffective in this position but as soon as the dial 10 turns so as to operate contacts 14 by the long pin 12 the solenoid is operated to advance the cam shaft CS into position 2. The signals remain the same in position 2 as in position 1 with the signal AG energized and the signals BR and CR energized, and all other signals deenergized, just as described in the preceding cycle without traffic actuation. In the present cycle however with traffic actuation, the closure of cam contacts 23 in position 2 now completes a circuit for energizing relay R from AC plus wire 100 via cam contacts 23, wire 86, relay contacts *dr*2, wires 87, 88, relay R, wire 89 to AC minus wire 101. Relay R is maintained energized by a locking circuit from AC plus wire 100 via cam contacts 24, wire 97, relay contacts *r*2, wire 88, relay R, wire 89, to AC minus, the relay contacts *r*2 being closed by the initial energization of relay R. The energization of relay R has also now opened the break contacts *r*1, *r*3, *r*5, *r*9, and has closed its contacts *r*4, *r*6, *r*7, and *r*8.

As soon as the dial 10 has turned sufficiently for the first pin 11 after the pin 12 to actuate contacts 13 the solenoid is operated again to advance the cam shaft to position 3. In this position the cam contacts 23 have opened so that the initial energization circuit described for relay R has now broken but relay R is maintained energized over the locking circuit described over cam contacts 24. In this position 3 the cam contacts 31 open thus deenergizing signal AG since the branch circuit for signal AG is also interrupted at the relay contacts *r*3, these circuits for signal AG having been previously described. Cam contacts 33 are closed in this position to energize the A yellow signal AY via wire 113, relay contacts *r*4, and wire 142. Cam contacts 38 and 41 remain closed to energize signals BR and CR respectively.

As soon as dial 10 has revolved so that the next pin 11 actuates contacts 13 the solenoid advances cam shaft CS to position 4. In this position cam contacts 33 are open to deenergize signal AY, the branch circuit for signal AY also being interrupted at relay contacts *r*5. Cam contacts 38 are also open in this position to deenergize signal BR, the branch circuit for signal BR being interrupted at the open contacts *r*9. Cam contacts 34 are closed in this position to energize signal AR via wire 114, relay contacts *r*6, wire 143. Cam contacts 36 are also closed to energize signal BG via wire 116, relay contacts *r*7, and wire 144.

In position 4 cam contacts 22 are opened and since relay contacts *r*1 are also open the locking circuit of relay DR is broken and this relay is deenergized in absence of detector actuation at this time. Any momentary traffic actuations of relay DR during the remainder of the timing period in cam shaft position 4 will have no permanent effect since relay DR has no locking circuit at this time. However, this locking circuit is reestablished again by the closure of contacts 22 when the cam shaft shifts from position 4 to position 5 so that any actuation at the end of position 4 will be locked in.

As soon as the next pin 11 operates contacts 13 by rotation of dial 10 the solenoid will advance the cam shaft to position 5, where the cam contacts 22 will be reclosed as just described.

The signal cam contacts remain the same in position 5 as in position 4 with the B green signal energized and the A and C red signals energized.

As soon as the next pin operates contacts 13 the cam shaft will be advanced to position 6. In this position cam contacts 32 open but this does not change the condition of signal AG since the circuit connecting with the cam contacts 32 is interrupted at the open relay contacts r3. Cam contacts 34 remain closed in position 6 so as to maintain signal AR energized via the closed relay contacts r6. Cam contacts 36 open in position 6 so as to deenergize signal BG, and cam contacts 37 close in position 6 so as to energize the B yellow signal BY via wire 117 and the closed relay contacts r3, and wire 145. Cam contacts 41 remained closed in position 6 to maintain signal CR energized.

When the next pin 11 is revolved to operate contacts 13 the cam shaft is advanced to position 7, in which the signal AR is maintained energized by continued closure of cam contacts 34. Cam contacts 35 become closed in position 7 to establish a branch energization circuit for signal AR via wire 115. Cam contacts 37 open in position 7 so as to deenergize signal BY. Cam contacts 38 close in position 7 to energize the B red signal BR via wire 113, wire 146. Cam contacts 39 also are closed in position 7 to energize signal CG.

Upon further rotation of dial 10 another pin 11 operates contacts 13 again so as to advance the cam shaft to position 8. In this position cam contacts 34 and 35 remain closed with cam contacts 35 maintaining signal AR energized by direct connection via wire 115 and wire 143. Cam contacts 24 open in position 8 so as to break the locking circuit of relay R via its contacts r2 as previously described, thus deenergizing relay R and restoring all of its contacts to the positions shown in the drawing. Cam contacts 39 open in position 8 to deenergize the signal CG. Cam contacts 38 remain closed to maintain signal BR energized, and a new branch circuit for energization of signal BR is completed by closure of relay contacts r9. Cam contacts 40 also close to energize signal CY, and cam contacts 41 remain open so that signal CR remains deenergized

As soon as dial 10 turns far enough for the next pin 11 to operate contacts 13 the cam shaft is advanced to position 1, which was the starting position for this cycle just described. Thus signals AG and CR are reenergized and signals CY and AR become deenergized. Signal BR remains energized via relay contacts r9.

Reviewing the two cycles of operation now described it will be observed that in absence of traffic actuation the relays DR and R were not operated and therefore the red signal on the B road was maintained deenergized throughout the cycle by relay contacts r9, the green signal for the B road maintained deenergized at relay contacts r7 and the B road yellow signal maintained deenergized at relay contacts r8, and that the green yellow and red signals for the A road were transferred by relay contacts r3 to r6 inclusive from one set of cam contacts to another so that the A road signal remained green through the B road positions 4 and 5 as well as the first A yellow position 3, and that the A yellow signal was actually energized only in the potential B yellow position 6. The effect of all these changes was that the cycle omitted the B road right of way period and yellow period and continued the A road green period up to the time when the B road yellow period would normally be given at which time the A yellow period was substituted.

In the case of the cycle in which traffic actuation occurred, however, the relays DR and R were operated thus changing the signal circuit connections to the cams in several instances so as to make the B road green signals effective in positions 4 and 5 in place of the red signal, and also to make the A yellow signal effective in position 3 and the B yellow signal effective in position 6, so as to introduce the B road right of way period in the cycle.

It should be noted that if traffic actuation has not ocurred before the end of the time period in position 2 or prior to this position following the last B green position in which the B green signal was displayed, the actuation will not be effective to operate relay R until the following cycle since the circuit for operation of relay R initially can be completed only in position 2 via cam contacts 23. It will be noted however that if traffic actuation occurred in position 3 without prior actuation the relay DR would be locked energized after such actuation, over cam contacts 22 and also over relay contacts r1 and via relay contacts dr1 as previously described. In this case however when the cam shaft operates through cam shaft position 4 and cam contacts 22 are open, the relay DR is maintained locked in via the closed contact r1 of relay R in the deenergized position of the latter relay. Thus these lock-in circuits assure that the relay R will subsequently be operated responsive to any operation of relay DR by traffic actuation, either in the immediate cycle or in the following cycle, to provide a right of way period for the B road responsive to the B road traffic actuation.

It will be understood that signal color sequences other than that here disclosed may be used if desired, by appropriate rearrangement of cams or signal circuit connections. For example if it is desired to employ overlapped red signals on all roads or lanes in lieu of a yellow signal in the change signal positions 3, 6 and 8 this can be done by lengthening the red signal control cams into the preceding change signal positions or by cross connecting each red signal circuit to its corresponding preceding yellow signal circuit, and omitting the yellow signal in each case. Obviously if desired the change signal periods could be divided into two parts over two adjacent positions by adding another pin 11 for each such division.

Other changes may obviously be made without departing from the spirit of the invention as defined by the appended claims.

I claim:

1. In a traffic signal controller having a time controlled cyclic switch mechanism and at least three switching positions through which the mechanism is operated periodically, three right of way signal circuits, a plurality of switches forming a part of said cyclic switch mechanism including three switches operated in sequence in three separate positions in the cycle of said mechanism and a fourth switch operated in two of said three positions, relay means operable responsive to traffic actuation and connected to said switch mechanism to be initially so operated in the first of said three positions of the cycle and to be maintained operated through the second of said three positions and thereafter released, switches interposed between two of said signal circuits and the switches of said mechanism and

operated by operation of said relay means to disconnect one signal circuit from the fourth switch and to connect a second signal circuit for operation by the second position switch, and a direct connection between the third signal circuit and the third position switch and a direct connection between said one signal circuit and the first position switch.

2. In a traffic signal controller having a time controlled cyclic switch mechanism and at least three switching positions through which the cyclic switch mechanism is operated periodically, three right of way signal circuits, a plurality of switches forming a part of said cyclic switch mechanism including three switches operated in sequence in three separate positions in the cycle of said mechanism and a fourth switch operated in two of said three positions, relay means operable responsive to traffic actuation and connected to said switch mechanism to be initialy so operated in the first of said two positions of the cycle and to be maintained operated through the second of said two positions and thereafter released, switches interposed between two of said right of way signal circuits and the switches of said mechanism and arranged to connect one signal circuit to the fourth switch and to disconnect a second signal circuit from all switches in the unoperated condition of said relay means, and to disconnect said one signal circuit from the fourth switch and connect the second right of way signal circuit to the second position switch in the operated condition of said relay means, and direct connections between the third signal circuit and the third position switch and between the first signal circuit and the first position switch.

3. In a traffic signal controller having a time controlled cyclic switch mechanism and at least three switching positions through which the cyclic switch mechanism is operated periodically, three right of way signal circuits, a plurality of switches forming a part of said cyclic switch mechanism including three switches operated in sequence in three separate positions in the cycle of said mechanism and a fourth switch operated in two of said three positions, switches interposed between certain of said signal circuits and certain of the switches of said mechanism, electromagnetc means connected with said cyclic switch mechanism to be operated initially in the first of said two positions responsive to traffic actuation and to be maintained operated thereafter through said two positions and then to be released, operative connection between said electromagnetic means and said interposed switches to connect one of said signal circuits to said fourth switch and disconnect a second of said signal circuits from the second position switch when said electromagnetic means is not operated, and to disconnect said one circuit from said fourth switch and connect said second circuit to said second position switch when said electromagnetic means is operated, and direct connections between said one signal circuit and the first position switch and between the third signal circuit and the third position switch.

4. In a traffic signal controller having a time controlled cyclic switch mechanism and at least three switching positions through which the mechanism is operated periodically, three right of way signal circuits, a plurality of switches forming a part of said mechanism including three switches operated in sequence in three separate positions in the cycle of said mechanism and a fourth switch operated in two of said three positions, switches interposed between certain of said signal circuits and certain of the switches of said mechanism, relay means adapted to be operated by traffic actuation, a second relay means controlled by said mechanism and by the first relay means to be operated initially in the first of said two positions by operation of said first relay means, means to maintain said first relay means so operated after initial operation in the first and third positions and to maintain it in the second position only responsive to non-operation of said second relay means and to release it in the second position responsive to operation of said second relay means, means to maintain said second relay means operated after initial operation in said first position and through said second position and to release said second relay means thereafter prior to the said first position in the next cycle of said mechanism, operative connection between said second relay means and said interposed switches to connect one of said signal circuits to said fourth switch and disconnect a second of said signal circuits from the second position switch when said second relay means is not operated, and to disconnect said one circuit from said fourth switch and connect said second circuit to said second position switch when said second relay means is operated, and direct connections between said one circuit and the first position switch and between the third signal circuit and the third position switch.

5. In a traffic signal controller having a time controlled cyclic switch mechanism and at least three switching positions through which the mechanism is operated periodically, three right of way signal circuits, a plurality of switches forming a part of said cyclic switch mechanism including three switches operated in sequence in three separate positions in the cycle of said mechanism and a fourth switch operated in two of said three positions, switches interposed between certain of said signal circuits and certain of the switches of said mechanism, relay means connected with said cyclic switch mechanism to be operated initially in the first of said two positions responsive to traffic actuation and having make contacts closed only when said relay means is operated, a second relay means having an operating circuit including another switch closed by said mechanism only in the first of said positions and one of the make contacts of the first relay means and having a holding circuit including a switch closed by said mechanism only in said first and second positions, said second relay means including make contacts closed only when said relay means is operated and break contacts opened only when said relay means is operated, a holding circuit for the first relay means including a switch closed by said mechanism only in the first and third positions, and a branch holding circuit for said first relay means including a break contact on said second relay means, a connection between one of said right of way signal circuits and said fourth switch of said mechanism via one of said break contacts, connection between a second of said signal circuits and the second position switch of said mechanism via one of the make contacts of said second relay means, and direct connections between the third signal circuit and a third position switch and between said one signal circuit and a first position switch of said mechanism.

6. In a traffic control apparatus for an intersection of two major roads and one relatively

minor road having right of way signals for the several roads, a traffic actuated device for the minor road only, and a cyclic controller operating repeatedly through a cycle of at least three operating positions controlling said signals in accordance with actuation and absence of actuation of the traffic actuated device, switches closed by said controller in said three positions respectively, and a fourth switch closed by said controller in the first and second positions, a relay connected to be operated by said traffic actuated device, a second relay connected to be operated by one of the first position switches of said controller responsive to operation of the first relay, switches controlled by said second relay, connections between said right of way signals and said controller switches via the switches of said second relay for operating the right of way signals for one major road in the first two positions and for the other major road in the third position respectively of said controller responsive to non-operation of said second relay and for operating the right of way signals for the two major roads in the first and third positions and the right of way signal for the minor road in the second position responsive to operation of said second relay.

7. In a traffic control apparatus for an intersection of two major roads and one relatively minor road having right of way signals for the several roads, a traffic actuated device for the minor road only, and a cyclic controller operating repeatedly through a cycle of at least three operating positions controlling said signals in accordance with actuation and absence of actuation of the traffic actuated device, switches closed by said controller in said three positions respectively, and a fourth switch closed by said controller in the first and second positions, a relay connected to be operated by said traffic actuated device, a second relay connected to be operated by one of the first position switches of said controller responsive to operation of the first relay, switches controlled by said second relay, connections between said right of way signals and said controller switches via the switches of said second relay for operating the right of way signals for one major road in the first two positions and for the other major road in the third position respectively of said controller responsive to non-operation of said second relay and for operating the right of way signals for the two major roads in the first and third positions and the right of way signal for the minor road in the second position responsive to operation of said second relay, and a holding means for said first relay connected with the first and third position switches of said controller to maintain said first relay operated in the first and third positions after initial operation by said traffic actuated device and also connected to be controlled by operation of said second relay to release said first relay in said second position responsive to operation of said second relay and to maintain said first relay operated through said second position responsive to non-operation of said second relay, a holding means for said second relay to maintain the latter operated through said first and second positions after initial operation and thereafter to release the latter before the first position in the next cycle.

8. In a traffic control apparatus for an intersection of two major roads and one relatively minor road having right of way signals for the several roads, a traffic actuated device for the minor road only, and a cyclic controller operating repeatedly through a cycle of at least three operating positions controlling said signals in accordance with actuation and absence of actuation of the traffic actuated device, switches closed by said controller in said three positions respectively, and a fourth switch closed by said controller in the first and second positions, a relay connected to be operated by said traffic actuated device and having make contacts closed only when the relay is operated, a second relay connected to a switch closed by said controller in the first position and to one of said make contacts to be operated by closure of both said switch and said contact and having a holding circuit including a switch closed by said controller through the first and second positions to maintain said second relay operated through the first and second positions and to release it thereafter before the first position is repeated, make contacts closed only by operation of said second relay and break contacts opened only by operation of said second relay, a connection between the right of way signal for the first major road and said fourth switch via a break contact of said second relay, a connection via a make contact of said second relay between the right of way signal for the minor road and a switch closed by said controller in its second position only, and direct connections between the first major road signal and a switch closed by said controller in its first position only and between the right of way signal for the second major road and a switch closed by said controller in its third position only.

9. In a traffic signal control apparatus for three traffic lanes having a cyclic switch controller and a plurality of switches operated thereby periodically through a cycle of switch operating positions including two right of way signal positions for the first lane, two right of way signal positions for the second lane and one right of way signal position for the third lane all in sequence, relay means operated by traffic on the second lane and connected with a controller switch to be maintained operated in all controller positions except the first right of way position for said second lane after initial operation by traffic, a second relay means connected to be operated initially by one of said controller switches operable in the second right of way position for the first lane responsive to operation of said first relay means and connected with a controller switch to be maintained operated through the second right of way position for the first lane and the two right of way positions for the second lane after such initial operation, switches controlled by said second relay means and connected between the right of way signals for said first and second lanes and the controller switches to operate the right of way signal for the first lane in the first four right of way positions responsive only to non-operation of said second relay means and to operate the right of way signal for the second lane in the two right of way positions for the second lane responsive only to operation of said second relay means, a connection between said first relay means and a switch operated by said second relay means in said first right of way position for the second lane to maintain said first relay means operated in the last named position responsive only to non-operation of said second relay means in said last named position, and direct connections between said right of way signal for the first lane and a controller switch

operated in the two right of way positions for the first lane and between the right of way signal for the third lane and a controller switch operated in the third lane right of way position.

10. In a traffic signal control apparatus for three traffic lanes having a cyclic switch controller and a plurality of switches operated thereby periodically through a cycle of switch operating positions including two right of way signal positions for the first lane, two right of way signal positions for the second lane and one right of way signal position for the third lane all in sequence, relay means operated by traffic on the second lane and having make contacts closed by such operation, a second relay means connected to a controller switch closed only in the second right of way position for the first lane and to one of said make contacts to be operated by closure of both contacts, make contacts closed only by operation of the second relay means and break contacts opened only by operation of the second relay means, a holding circuit for the first relay means including a controller switch closed in all positions except the first right of way position for said second lane and a branch holding circuit for said first relay means including a break contact of said second relay means, a holding circuit for said second relay means including a controller switch closed in all of said controller positions except the first position for said first lane, a direct connection between the right of way signal for the first lane and a controller switch closed in the first two right of way positions only, a connection between the right of way signal for the first lane and a controller switch closed in the first four right of way positions via one of said break contacts, a connection between the right of way signal for the second lane and a controller switch closed only in the two right of way positions for the second lane via one of the make contacts of said second relay, and a direct connection between the right of way signal for the third lane and a controller switch closed only in the right of way position for the third lane.

11. In a traffic signal control apparatus for three traffic lanes having a cyclic switch controller and a plurality of switches operated thereby through a periodic cycle of operating positions including at least one right of way signaling position and a following signal change position for each lane in sequence, a go signal circuit, a stop signal circuit and a change signal circuit for each lane, a traffic actuated device for the second lane, a first relay means connected to be operated initially by actuation of said traffic actuated device and connected with a controller switch to be maintained operated in all except one right of way position for the second lane after such initial operation, a second relay means connected to be operated initially by one of said controller switches operable in one right of way position for the first lane responsive to operation of said first relay means and connected with a controller switch to be maintained operated from said last named position through the right of way position for the third lane and thereafter to be released, make contacts closed only by operation of said second relay means and break contacts opened only by such operation, a connection between said first relay means and one of said break contacts to maintain said first relay means operated after initial operation in said one right of way position for said second lane responsive to non-operation of said second relay means, connections via said make contacts between the go and change signal circuits for said second lane and the controller switches operated in the corresponding controller positions and between the change signal circuit for said first lane and the corresponding controller switch and between the first lane stop signal circuit and a controller switch operated in all except the right of way and change positions for the first lane, connections via said break contacts between the second lane stop signal circuit and power supply and between the first lane go signal circuit and a controller switch closed from the first lane right of way position through the second lane right of way position and between the first lane change signal circuit and the controller switch operated in the change position for the second lane, and direct connections between the first lane go signal circuit and a controller switch operated in the first lane right of way position and between the first lane stop signal circuit and a controller switch operated in the third lane right of way and change positions, and further direct connections between the go, change and stop signal circuits for the third lane and corresponding controller switches therefor.

12. In a traffic signaling apparatus having three right of way signal circuits, and a cyclic controller having a plurality of switches and operating said switches periodically through a time cycle normally providing two alternate periods for operation of two right of way signal circuits but also adapted to provide three periods for operation of three right of way signal circuits, traffic actuated relay means having switches interposed between certain of said controller switches and certain of said signal circuits to select between said controller switches to include the third right of way period in the cycle in place of a part of one of the other two periods responsive only to traffic actuation.

13. In a traffic signaling apparatus having three right of way signal circuits, and a cyclic controller having a plurality of switches and operating said switches periodically through a time cycle normally providing two alternate periods for operation of two right of way signal circuits but also adapted to provide three periods for operation of three right of way signal circuits, relay means having switches interposed between certain of said controller switches and said signal circuits and operable to select between controller switches to include the third right of way period in the cycle in place of a part of one of the other two periods, relay means for operation by traffic actuation, connections between the first mentioned relay means and one of the controller switches and the traffic operated relay means to so operate said first mentioned relay means in advance of said part of one period by operation of said traffic operated relay means, and holding means controlled by said first mentioned relay means and by one of the controller switches to maintain the traffic operated relay means operated after traffic actuation and until said third right of way period has been provided in the cycle.

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