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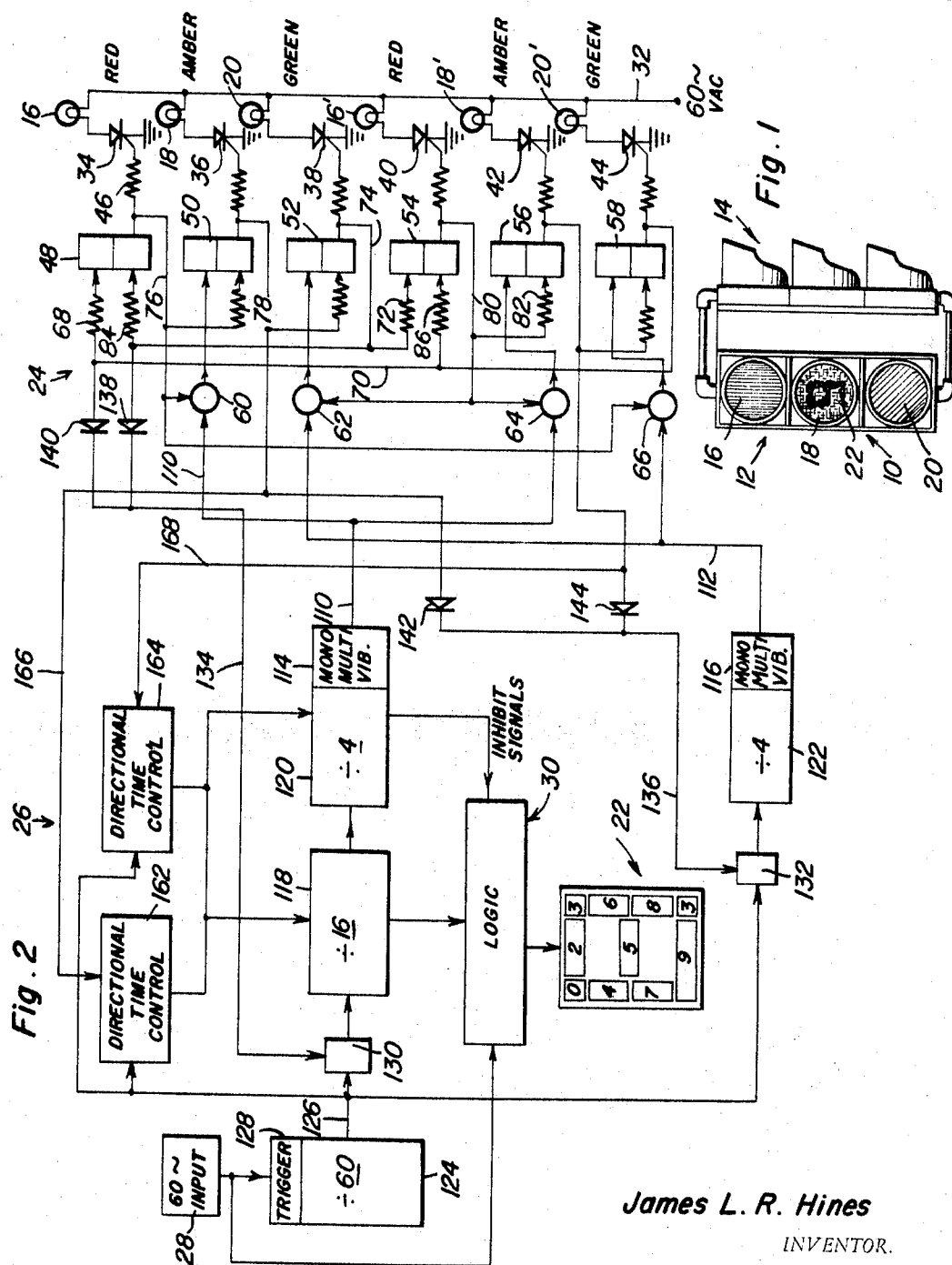
J. L. R. HINES

3,480,909

TIME COUNTING TRAFFIC SIGNALLING SYSTEM.

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2 Sheets-Sheet 1



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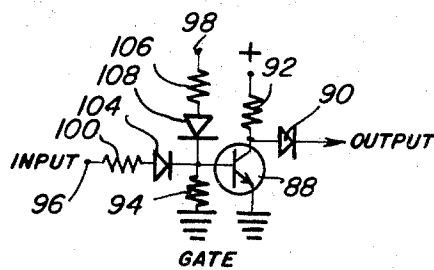
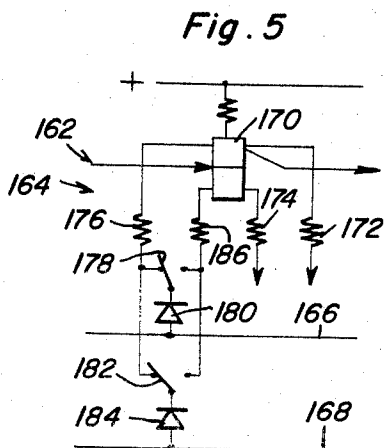
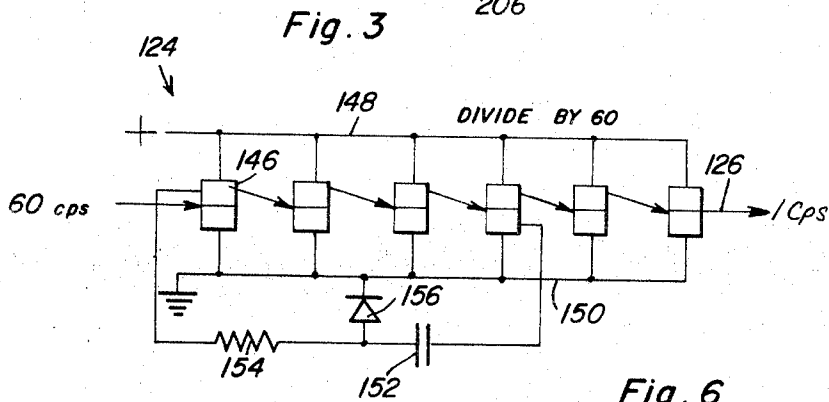
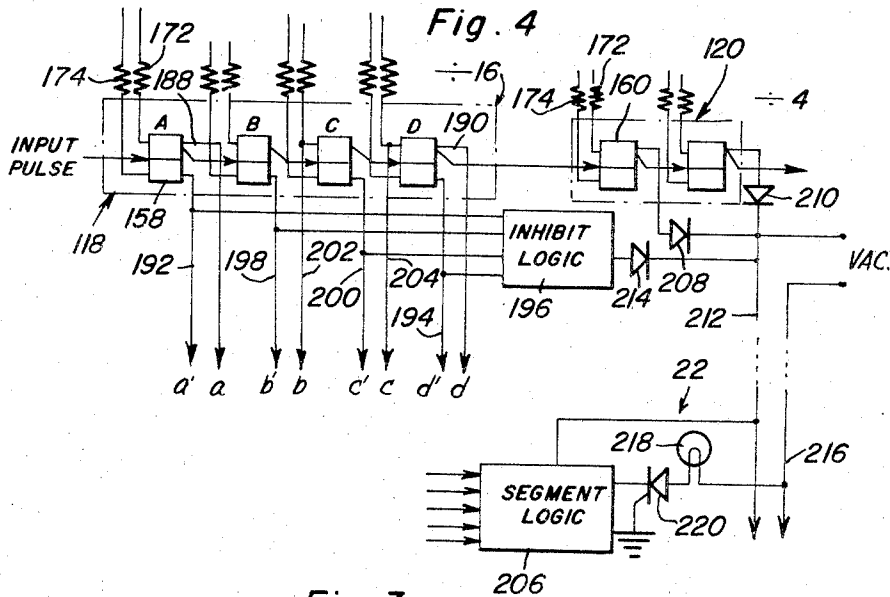
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TIME COUNTING TRAFFIC SIGNALLING SYSTEM

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TIME COUNTING TRAFFIC SIGNALLING SYSTEM

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4 Claims

This invention relates to a combined traffic signal and time countdown control system.

The control system of the present invention is associated with a cyclically operative traffic change signal assembly having green, amber and red signal lamps as well as a time countdown device to inform motorists of the time elapsed during the illumination period of the green signal lamps. In accordance with the present invention, the countdown device is located in the amber signal lamp through which illuminated number characters are displayed.

Cyclic operation of the traffic signalling lamps and the countdown device is controlled by a solid state controller utilizing timing pulses derived from the fixed frequency of the source of A.C. current from which the signal lamps are energized.

The solid state controller in accordance with the present invention includes a lamp control section having a plurality of gate controlled bistable multivibrators or flip-flops through which the signal lamps are switched on and off in a predetermined sequence. A timing section associated with the controller supplies gated signals to the lamp control section in order to determine the duration of the lamp sequence cycle. The gated signals are derived from counters within the timing section which count timing pulses originating from the frequency of the A.C. power source. The timing pulses supplied to the counters are also gated by sequence controlling signals from the lamp control section. One of the counter assemblies within the timing section determines the duration of the illumination periods for the green signal lamps under control of directional timers and also furnishes timing pulses to a logic circuit wherein the timing pulses are decoded into a decimal output read-out by a countdown display device consisting for example of a patterned arrangement of lamp segments visible through the amber signal lamp.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of a typical traffic signalling and countdown assembly with which the present invention is associated.

FIGURE 2 is a simplified circuit diagram corresponding to the control system of the present invention.

FIGURE 3 is a circuit diagram showing one of the counters associated with the control system from which the timing pulses are derived.

FIGURE 4 is a circuit diagram of a portion of the control system showing the logic circuit components and counter components with which it is associated.

FIGURE 5 is a circuit diagram showing a portion of the timer components associated with the control system shown in FIGURE 2.

FIGURE 6 is a circuit diagram showing one of the gates utilized in the control system of the present invention.

Referring now to the drawings in detail, FIGURE 1 illustrates the traffic signalling assembly generally referred to by reference numeral 10 which shows two directional lamp sections 12 and 14. Each lamp section is similar in

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construction and includes an upper stop lamp 16 which is red in color, an intermediate slow lamp 18 which is amber in color and a lower go lamp which is green in color when illuminated. The amber lamp also displays separate bulb illuminated segments of a time countdown display device 22 which is operative during the illumination period of the green lamp 20 to inform motorists of the time which remains within the illumination period of the green lamp.

As shown in FIGURE 2, illumination of the signal lamps 16, 18 and 20 facing one direction as well as the corresponding lamps 16', 18' and 20' facing another direction are connected to a lamp control section 24. The control section 24 predetermines the sequence in which the signal lamps are illuminated and extinguished under control of a timing section generally referred to by reference numeral 26 to which the lamp control section is connected. The time base for the timing section is derived from the fixed 60 cycle frequency of the A.C. source of electrical energy 28. The timing section is operative to supply signal pulses to the lamp control section at the proper instances during each operational cycle while during a portion of each cycle, pulses are fed to the logic circuit 30 for decoding into decimal information fed to the time countdown device 22 aforementioned.

All of the signal lamps as shown in FIGURE 2, are connected to the voltage supply line 32 at one of its terminals, the other terminals of the signal lamps being respectively connected to silicon controlled rectifiers 34, 36, 38, 40, 42 and 44. The control electrode at each silicon controlled rectifier is connected by a resistor 46 to the single output terminal of one of a plurality of bistable multivibrators or flip-flops 48, 50, 52, 54, 56 and 58. Thus, the six flip-flops respectively control the illumination of a corresponding signal lamp by being switched on to supply an output voltage from its single output terminal to the control electrode of one of the silicon controlled rectifiers through a resistor 46 in order to complete an energizing circuit to ground from the voltage line 32 through the associated signal lamps. Each flip-flop includes two input terminals through which it is respectively switched on and off by supply of a signal voltage thereto. The flip-flops 50, 52, 56 and 58 are respectively switched on by signal pulses from the timing section 26 gated by gates 60, 62, 64 and 66 connected to the switch-on input terminals of the latter mentioned flip-flops in order to control the illumination of the amber and green signal lamps for each direction. The red signal lamps 16 and 16' on the other hand are illuminated when the corresponding flip-flops 48 and 54 are switched on by signal pulses derived internally of the lamp control section.

Beginning with illumination of the green lamp, the green lamp illumination period in each lamp section is to be followed by an amber lamp illumination period and then a red lamp illumination period to complete one cycle synchronized with the operational cycle of the other directional lamp section so that only the green and red lamps are simultaneously illuminated. The switch-on input terminal of flip-flop 48 is therefore connected by the resistor 68 and conductor 70 to the output terminal of flip-flop 58. It will be apparent therefore, that whenever the green lamp 20' is illuminated for one direction, the red lamp 16 for the other direction is also illuminated. Similarly, the flip-flop 54 associated with a red signal lamp 16' is switched on whenever the green lamp 20 in the other direction is switched on and toward this end, the switch-on input terminal of flip-flop 54 is connected by resistor 72 and conductor 74 to the output terminal of flip-flop 52. Whenever a red lamp in any lamp section is turned on, the amber lamp in the same lamp section must be turned off and prevented from being

turned on during the illumination period for the red lamp. Therefore, the output terminal of flip-flop 48 associated with the red signal lamp 16 is connected by conductor 76 to the gate 60 in order to prevent passage of any signal therethrough and is also connected to the switch-off input terminal of flip-flop 50 through resistor 78. Similarly, the output terminal of flip-flop 54 for the red signal lamp 16' is connected by conductor 80 to the gate 64 and through resistor 82 to the switch-off input terminal for flip-flop 56. When the red signal lamps are illuminated, it is also essential that the green signal lamps in the same lamp sections are turned off. The output terminals of the flip-flops 48 and 54 are therefore also respectively connected to the gates 66 and 62 by the conductors 76 and 80 in order to prevent passage of any switch-on signals to the flip-flops 58 and 52 respectively associated with the green lamps 20' and 20. Finally, whenever a green lamp is turned on, the red lamp in the same lamp section must be switched off. The output of flip-flop 52 associated with green lamp 20 is therefore connected by conductor 74 and resistor 84 to the switch-off input terminal of flip-flop 48 while the output terminal of flip-flop 58 associated with green signal lamp 20' is connected by conductor 70 and resistor 86 to the switch-off input terminal of flip-flop 54 associated with the red signal lamp 16'. It will be apparent therefore, that the flip-flops are interconnected with each other and with the signal gates 60, 62, 64 and 66 in order to insure that the signal lamps are illuminated and extinguished in the proper sequence during each timing cycle.

As hereinbefore indicated, properly spaced signals are fed to the control gates 60, 62, 64 and 66 in order to effect cyclic operation of the signal lamps in the sequence predetermined by the lamp control section 24. Each control gate as shown in FIGURE 6 includes for example a PNP type of transistor 88 having a grounded emitter and an output collector connected by diode 90 to the switch-on input terminal of one of the flip-flops 50, 52, 56 or 58. A source of positive voltage is connected to the collector of the transistor through resistor 92 in order to supply signal voltage to the switch-on input terminal that is reduced whenever the transistor 88 is switched off by a positive voltage of sufficient value supplied to the base thereof. A forward bias for the base of transistor 88 above ground is established by the resistor 94. Terminal 96 is connected to the base through resistor 100 and diode 104 while terminal 98 is connected to the base through resistor 106 and diode 108. Thus, whenever there is a relatively low voltage at both the terminals 96 and 98, the transistor 88 is switched on in order to reduce the voltage at the collector thereof causing an associated flip-flop to switch on.

Referring to FIGURE 2 once again, it will be apparent therefore that a signal supplied to the gate 60 from the timing section through conductor 110 will switch on flip-flop 50 to illuminate amber signal lamp 18 only following an illumination period for the green signal lamp 20 but not following an illumination period for the red signal lamp 16 since the output of flip-flop 48 establishes a relatively high positive voltage in the conductor 76 to prevent the gate 60 from transmitting the signal. Switching on of the flip-flop 50 switches off the flip-flop 52 so as to terminate the illumination period for the green lamp 20. The signal in line 110 transmitted by gate 60 to turn on the amber lamp 18, cannot be transmitted through gate 64 because at that instant the flip-flop 54 is on to illuminate the red signal lamp 16'. In order to terminate the illumination period for the amber signal lamp 18, a signal supplied to conductor 112 is passed through the gate 66 in order to switch on flip-flop 68 which in turn switches on flip-flop 48. Accordingly, the red lamp 16 is turned on in the same lamp section in which the amber lamp 18 is located in order to switch off the flip-flop 50 associated therewith while the green lamp 20' in the other directional lamp section is turned on. The next signal supplied to conductor 110 will then be passed through gate 64 instead of gate 60 in order to turn on the amber lamp 18'

in the same lamp section as the green signal lamp 20' and terminate the illumination period of the green signal lamp 20'. Finally, the next signal supplied to conductor 112 will be passed through gate 62 and not gate 66 in order to start a new cycle.

Properly spaced signals are therefore transmitted to the conductors 110 and 112 from the timing section. These signals are derived from the switching of monostable multivibrators 114 and 116 to their unstable states producing a reduction in the relatively high voltage held on the input terminals 96 associated with the control gates 60, 62, 64 and 66. The monostable multivibrator 114 is switched to its unstable state in order to generate the signal in conductor 110 in response to an output pulse from a counter component consisting of the series connected counters 118 and 120. The monostable multivibrator 116 on the other hand is triggered into its unstable state by an output pulse from the counter 122. Both counters 118 and 122 count timing pulses derived from a divide by sixty counter 124 producing timing pulses at output 126 of one pulse per second. The counter 124 is therefore supplied with sixty pulses per second from the Schmitt trigger 128 receiving the 60 cycle input from source 28. The timing pulses fed to the counters 118 and 122 are gated by means of the counter gates 130 and 132 under control of signal voltage respectively supplied thereto by the conductors 134 and 136 from the lamp control section 24. Thus, the outputs of flip-flops 52 and 58 are respectively connected by diodes 138 and 140 to the signal voltage line 134 while diodes 142 and 144 connect the outputs of flip-flops 50 and 56 to the signal voltage line 136. The duration of the illuminating period for the green signal lamps respectively associated with flip-flops 52 and 58 are controlled by the counters 118 and 120 to which timing pulses are fed through gate 130 as long as the flip-flops 52 and 58 associated with the green lamps are switched on to establish signal voltage in the line 134. Similarly, the duration of the illumination period for the amber lamps 18 and 18' is determined by the counter 122 to which timing pulses are fed through gate 132 as long as the flip-flops 50 and 56 are switched on to establish a signal voltage in the line 136 to the gate 132. The counter 122 is a divide by four counter so that it will produce an output pulse every four seconds operative through the monostable multivibrator 116 to turn on one of the green signal lamps. The counters 118 and 120 on the other hand respectively divide by sixteen and divide by four counters in order to count sixty-four timing pulses before establishing a signal in line 110 through the monostable multivibrator 114 in order to initiate an illumination period for one of the amber signal lamps terminating a preceding illumination period for a green signal lamp.

The aforementioned counters comprise an array of series connected, bistable multivibrators in a well known arrangement. For example, the counter 124 illustrated in FIGURE 3 includes six series connected bistable multivibrators 146 the first of which is triggered by input pulses from the output 126 at a rate of one pulse per second. The multivibrators 146 are supplied with a positive voltage through the voltage line 148 for establishing the proper bias above the ground line 150 to which the multivibrators are also connected. One output of each multivibrator triggers the following multivibrator causing it to switch from one state to the other. The fourth multivibrator is provided with a second output connected to the input of the first multivibrator through a feed back path including the series connected capacitor 152 and resistor 154. The duration of the signal fed through the feed back path is controlled by the capacitor 152 and the diode 156 connecting the juncture of the capacitor 152 and resistor 154 to ground. It should also be appreciated, that the counter 124 will include a duplicate circuit as illustrated in FIGURE 3 where there are two lamp sections for each direction.

The counter 118 as shown in FIGURE 4 consists of

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four series connected multivibrators 158, each multivibrator including two outputs with the output 160 also providing the trigger for the following multivibrator in order to cause it to switch from one state to the other. The trigger output of the fourth multivibrator in counter 118 is connected to the trigger input of the counter 120 which includes two multivibrators 160. Each multivibrator 160 includes a single output from which the second multivibrator 160 is triggered which in turn triggers the monostable multivibrator 114 to its unstable state after four pulses supplied to the counter 120 from the counter 118 are counted. Further, each of the counters 118 and 120 as illustrated in FIGURE 4, may be duplicated in order to accommodate two lamp sections for each direction,

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timers being set by signal voltage in either line 166 or 168 dependent upon the position of the switches 178 and 182 associated therewith. Each timer is set by counting a predetermined number of pulses supplied thereto during the amber illumination period. Accordingly, the remainder of the count before the timer is reset to zero occurs while the timer is supplied with timing pulses simultaneously with the supply of such timing pulses to the counters 118 and 120 in order to determine the fixed timing period during which the timers 118 and 120 are prevented from counting timing pulses.

The operational sequence for the various components hereinbefore described may be summarized by reference to the following chart:

CHART I

Lamps On						Lamp Control Gate Opened				Counter Gate Opened		Timer Being Set	
Direction A			Direction B			Dir. A		Dir. B					
20	18	16	20'	18'	16'	52	50	58	56	130	132	162	164
X					X	X	X			X	X		X
	X							X		X		X	
		X	X						X	X			
		X		X					X	X			

From the foregoing, it will be apparent that the duration of the illumination period for the green signal lamps will be sixty-three seconds under control of the series connected counters 118 and 120 while a four second illumination period for the amber signal lamps will be determined by the divide by four counter 122. The timing pulse count of the series connected counters 118 and 120 however is reduced by a predetermined amount in each direction in order to regulate the duration of the green lamp illumination period. The reduction in the pulses counted by the counters 118 and 120 will be controlled by the directional control components or timers 162 and 164 as shown in FIGURE 2. Depending upon the direction in which the illumination period is being timed, one or the other of the timers 162 and 164 will count a fixed number of timing pulses supplied thereto from the output 126 of the counter 124. When the count is completed, the timer is reset to zero. At the same time that the timing pulses are being counted by one or the other timers 162 and 164, they are also being fed to the counters 118 and 120 to which the timers 162 and 164 are connected in order to prevent the counters 118 and 120 from proceeding with the count. The timers 162 and 164 are accordingly set during the amber illumination period and toward this end, the output of flip-flop 60 associated with amber signal lamp 18 is connected by the timer set line 166 to the timer 162 while the output of flip-flop 56 associated with the other amber signal lamp 18' is connected by the timer set line 168 to the timer 164. The timers 162 and 164 are formed by an array of eight bistable multivibrators 158 corresponding to the eight multivibrators 158 and 160 associated with the counters 118 and 120. As shown in FIGURE 5, the multivibrators 170 associated with the timers include a trigger output for the following multivibrator connected by resistor 172 to one of the counters 118 and 120 and a second output connected by the resistor 174 to one of the counters 118 and 120. A pair of inputs is also associated with each multivibrator 170 with one input being connected through the resistor 176, switch 178 and diode 180 to the timer set line 166 and through the switch 182 and diode 184 to the other timer set line 168. Operation of the timers may be reversed by displacement of the switches 178 and 182 to the other operative positions shown in FIGURE 5 connecting the other input of the multivibrator to the lines 166 and 168 through resistor 186. Accordingly, each of the multivibrators 158 and 160 in the counters 118 and 120 are interconnected with corresponding multivibrators 170 in the timers, the

At the same time that the multivibrators 158 of counter 118 are being switched from one state to the other during the pulse counting operation, pulses are supplied from the trigger outputs 188 and 190 of the first and last multivibrators of the counter 118 to the logic circuit 30 in order to decode the timing pulses into a decimal output. As shown in FIGURE 4, the other outputs 192 and 194 of the first and last multivibrators in the counter 118 are connected to an inhibit logic component 196 to which the outputs 198 and 200 are also connected from the other multivibrators in the counter 118. Signal lines 202 and 204 are also associated with the third and fourth multivibrators in the counter 118 so as to establish a pair of signal lines associated with each of the four multivibrators 158 and the inhibit logic component 196 forming inputs to nine segment logic components 206. The outputs of the multivibrators 160 of counter 120 are connected by diodes 208 and 210 to an inhibit signal line 212 to which the inhibit logic 196 is connected by diode 214. The inhibit signal line 212 is also connected to each of the nine segment logic components 206 while a supply voltage line 216 supplies energizing current to the segment bulbs 218 connected by silicon controlled rectifiers 220 to each of the segment logics 206. Different combinations of signal lines associated with each of the multivibrators 158, labeled A, B, C and D in FIGURE 4 are connected to the respective segment logics 206 as outlined in the following Chart II:

CHART II

Counter Outputs	
Segment Logic:	
1.....	a' b' c' d'
2.....	a' ab' bc' d'
3.....	a bc' cd
4.....	a bb d'
5.....	a' b' bc' cd'
6.....	b' c
7.....	a' bc'
8.....	a' b' c'
9.....	a' bc'

The successive pulses counted by the counter 118 will produce a negative output pulse in the proper segment logics switching on the corresponding silicon controlled rectifiers 220 in order to illuminate the associated segment lamp bulbs. Accordingly, each pulse counted by the counter will cause illumination of different combinations of segment bulbs 218 as outlined in the following Chart III in order to produce an illuminated character number on the display device 22 shown in FIGURE 2 in

which the segments are labeled by numbers in accordance with Chart III:

CHART III

Display No.:	Segments Illuminated								
	1	2	3	4	5	6	7	8	9
9	X	X	X	X	X	X		X	X
8	X	X	X	X	X	X	X	X	X
7	X	X	X			X		X	X
6	X	X	X	X	X		X	X	X
5	X	X	X	X	X			X	X
4	X	X	X	X	X	X		X	X
3	X	X	X		X	X	X	X	X
2	X	X			X	X	X		X
1			X			X		X	

The inhibit signal supplied to the segment logics through inhibit signal light 212 are derived from the outputs of the multivibrators 160 in counter 120 and the inhibit logic 196 connected to the outputs of the multivibrators 158 in the counter 118 in order to prevent decoding operation of the segment logics 206 during the interval when the counters are prevented from proceeding with the full count by the timers 162 and 164 as aforementioned. Thus, the pulses from the counter 118 will be decoded into a decimal read-out of the display device 22 only during the illumination period of the green signal lamps controlled by the counters 118 and 120.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In combination with a plural direction traffic signalling assembly having three different signal lamps for each direction and time countdown display means, a controller for governing operation of the signalling assembly and the countdown display means comprising, a lamp control section having a plurality of switching devices respectively connected to each of the signal lamps for rendering the same operative and inoperative, control gate means operatively connected to said switching devices for externally controlling operation of two of the signal lamps for each direction and means interconnecting said switching devices and the control gate means for internally controlling operation of the third signal lamp for each direction in a predetermined sequence with the two signal lamps, a timing section connected to said control gate means of the lamp control section for supply of timed signal pulses to sequentially operate the switching devices during a timing cycle, and logic circuit means connecting the timing section to the display means for displaying timing information during a portion of said

timing cycle when one of said two externally controlled signal lamps is operative.

2. The combination of claim 1 wherein said timing section comprises, a source of timing pulses, a pair of counters connected to the control gate means of the lamp control section for supplying said signal pulses in response to counting different members of said timing pulses, a pair of counter gates connecting said source of timing pulses to the counters, timer means connected to one of the counters and operative when set to reduce the number of timing pulses counted thereby, means connecting two of the switching devices to one of said counter gates for transmitting timing pulses to said one of the counters when said one of the two externally controlled signal lamps for each direction is operative, and means connecting another two of the switching devices to the other of the counter gates and the timer means when the other of said two of the signal lamps is operative for setting the timers and transmitting timing pulses to the other of the counters.

3. The combination of claim 1 wherein said one of the counters includes a pair of series connected counter sections, one of said counter sections being connected to said one of the counter gates and the logic circuit means for supply of display pulses thereto, the other of the counter sections being connected to the logic circuit means for supply of inhibit pulses thereto to limit operation of the display means to said portion of the timing cycle.

4. In combination with a plural direction traffic signalling assembly having three different signal lamps for each direction and time countdown means, a controller for governing operation of the signalling assembly and the countdown means comprising, a source of timing pulses, a pair of counters for counting different numbers of said timing pulses, a pair of counter gates connecting said source of timing pulses to the counters, a lamp control section connected to the signal lamps for operation thereof in a sequence controlled by said counters, means connecting said lamp control section to the counter gates for transmitting timing pulses to the counters when two of the signal lamps for each direction are operative, logic circuit means connecting one of the counters to the countdown means for displaying timing information during a portion of the timing cycle of said one of the counters, and timer means connected to the lamp control section for determining the timing cycle of said one of the counters when one of said two signal lamps is operative.

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