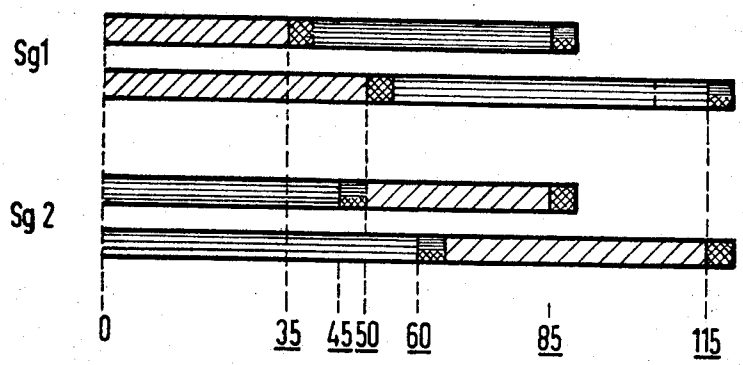
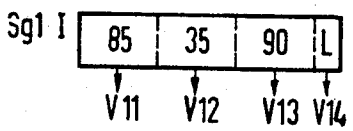
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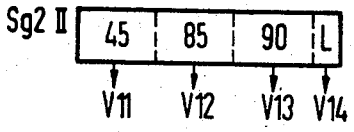
CONTROL UNITS FOR PROGRAMMED OPERATION OF TRAFFIC SIGNALS

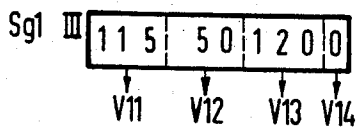
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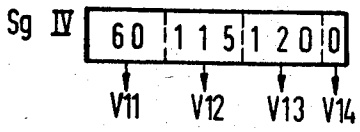
Fig.1




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CONTROL UNITS FOR PROGRAMMED OPERATION OF TRAFFIC SIGNALS

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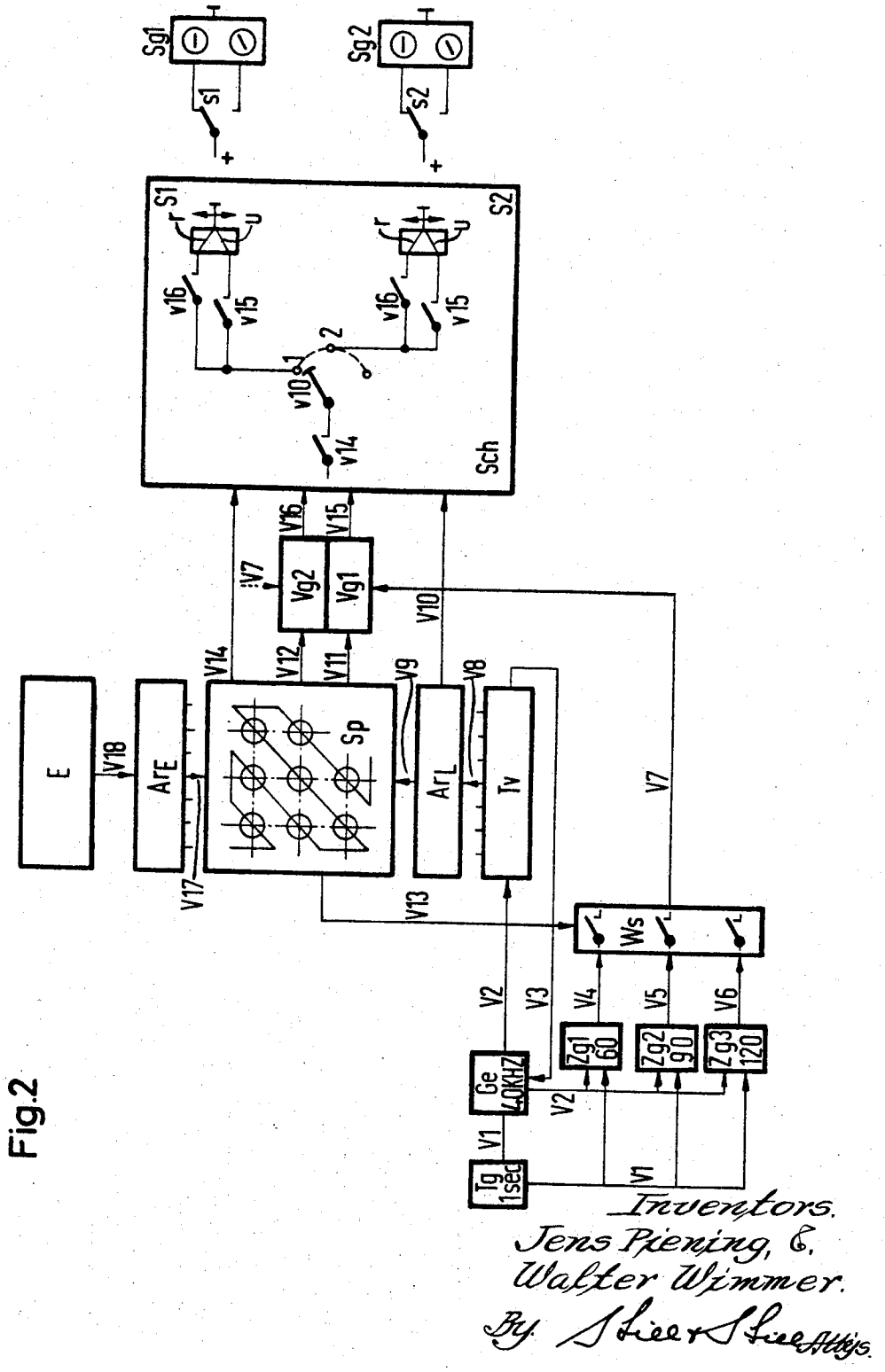



Fig.2

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3,375,494

# CONTROL UNITS FOR PROGRAMMED OPERATION OF TRAFFIC SIGNALS

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## ABSTRACT OF THE DISCLOSURE

A traffic signal unit for programming the operation of a plurality of sets of traffic signals having lamps controlled by lamp switches, comprising a storage register having storage elements disposed in a plurality of groups which form respective storage cells for storing switching programmes for the lamps of the individual signal sets, a pulse generator, at least one pulse counter operatively connected to said generator for counting pulses from said pulse generator, means for effecting a sampling of each cell once between successive pulses from such pulse counter, a comparator operatively connected to such a cooperable pulse counter and said register for comparing the information in each sampled cell with the pulse count contained such cooperable pulse counter at the time when that cell is sampled, and means for transmitting a signal to control the actuation of lamp switches of the traffic signal sets when the pulse count applied to the comparator corresponds to the sampled information applied to the comparator.

This invention relates to traffic signal control units for programming the operation of a plurality of sets of traffic signals.

One known type of control unit for programming the operation of traffic signals involves considerable complexity of construction in programming of the individual traffic signal programmes, since the circuit connections thereof can only be made at a given point by plug transfer or by changing and re-soldering wiring connections. In addition, the unit must be taken out of service for long periods to effect changes, and checking of the system for correct operation after effecting such changes is only possible when the unit has been returned to service. Proposals have therefore been made to use programme plates in the form of cross-bar type panels in traffic signal control units, one such programme plate being provided for each particular programme so that by exchanging plates pre-determined programmes can be easily implemented without need for taking the control unit out of service. However, control units of this type no longer meet the demands of modern traffic which are ever becoming more stringent. The wide variety of traffic conditions which are now required to be controlled require that traffic signal control units have even more flexibility than is provided by programme plate circuits, and control units are now required which can be adapted to operate in accordance with programmes based upon continuously changing traffic conditions.

One of our objects in this invention is to provide an improved and extremely flexible traffic signal control unit for programming the operation of a plurality of sets of traffic signals, which unit will meet requirements of modern road traffic control and, without the need for any special circuitry changes, can be simply programmed and changed by the operation of, for example, setting knobs, pushbuttons or keys.

The present invention consists in a traffic signal control unit, for programming the operation of a plurality



of sets of traffic signals, including a storage register having storage elements grouped to form a plurality of storage cells associated with the individual sets of traffic signals, wherein at least one pulse counter counts pulses from a pulse generator and returns to zero after a predetermined number of pulses have been counted, wherein the storage cells can store switching programmes for the lamps of the individual signal sets, wherein each cell can be sampled once between successive pulses from the pulse counter, wherein a comparator is provided to compare the information in each sampled cell with the pulse count contained in the cooperable pulse counter at the time when that cell is sampled, and wherein a signal is transmitted to control the switching of the lamp switches of the traffic sets when the pulse count applied to the comparator corresponds to the sampled information applied to the comparator.

Preferably the circuit includes a plurality of pulse counters which return to zero after counting different predetermined numbers of pulses, and each programme stored in the register includes instructions for selecting a particular one of said pulse counters.

In control units in accordance with the present invention it is possible to feed any required programme into the storage register at any time, using appropriate means, and thus to control the traffic signal installation in a manner appropriate to a given traffic situation.

One embodiment of a control unit in accordance with the present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a diagram illustrating the operating sequences of two traffic signal sets for different timing cycles;

FIGURE 2 illustrates a programming unit according to the invention in block diagram form; and

FIGURE 3 schematically shows associated control signal information which is stored in four storage cells of a register Sp incorporated in a programme unit of the invention.

Referring to FIGURE 1, two traffic signal sets Sg1 and Sg2, represented by the upper part of the drawing, control converging flows of traffic during two timing cycles of 90 and 120 seconds. As the center and lower diagrams of the drawing indicate, the necessary control information elements are fed into the storage cells I to IV, the cells I and II respectively and directly controlling the respective signal sets Sg1, Sg2 by means of the switching command L stored in the last column of each of these cells. In addition, via the connection V11 the operating times 85 or 45 seconds for the GO lamps of the signal sets Sg1 and Sg2 are signalled and via the connection V12 the operating times 35 or 85 seconds for the STOP lamps of these same sets; also, via the connection V13, the timing cycle of 90 seconds is signalled to a timer.

Referring also to FIGURE 2, when the programming unit is switched in, a timing pulse generator Tg transmits pulses at one second intervals through the connection V1' to a 40 kc./s. frequency generator Ge, which is thereby set going. The generator Ge then transmits pulses via a connection V2 and a pulse distributor TV to sample the storage cells in a storage register Sp, until the end of a sampling cycle, when it is switched off via a connection V3. In addition, the pulses from the pulse generator Tg are also transmitted via connections V1 to pulse counters Zg1, Zg2 and Zg3 serving as timers where these pulses are stored, which counters start again from zero at the end of a timing cycle allotted to them, i.e., the counter Zg1 after 60 pulses, the counter Zg2 after 90

pulses and the counter Zg3 after 120 pulses. This means that the counters Zg1 to Zg3, at any given time, store the actual time of the three possible cycles. Thus, if, for instance, after switching on of the unit, 100 pulses have been transmitted by the timing pulse generator Tg1, the timer Zg1 will show 40, the timer Zg2 will show 10 and the timer Zg3 100. These counts are continuously sampled by the general Ge and transmitted to a selector switch Ws via connections V4 to V6. The selector switch Ws then transmits one of these counts, depending on which of the contacts of the selector switch Ws is closed via the connection V13, to comparator devices Vg1 and Vg2 via a connection V7.

By means of an address register $Ar_L$, operating as an information allocator, all the storage cells I, II and so on in the register Sp are successively sampled by the pulses from the distributor TV. If, for instance, storage cell I is sampled its third column transmits the switching command 90 to the selector switch Ws. This command is consequently transmitted in binary code as part of the word stored in storage cell I via the pulses of the generator Ge to the selector switch Ws. The selector switch Ws contains a decoder, which is not shown in the drawing, which, as a result of this switching command, causes the middle contact of the three contacts shown to close. The sampling of storage cell I will therefore cause a connection to be established from the pulse counter Zg2 to the comparator devices Vg1 to Vg2. In view of the fact that only three contacts are in the selector switch Ws, column 3 of the storage cells I to IV need store only three different switching commands, e.g. 1, 2, 3, in order to identify the three contacts. However, in order to indicate the cycle time of the counters Ag1 to Ag3, and at the same time to make it clear which of the counters Zg1 to Zg3 is connected by a specific storage cell to the comparator devices Vg1, Vg2, provision is made for storing the cycle times of each counter in column 3 of the storage cells I to IV to act as switching commands. Each of the numbers "60, 90 or 120" consequently indicates that, at that particular moment, the corresponding contact in the selector switch Ws is closed. At the same time, via a connection V10, the relationship between the cells I, II and so on and individual bistable switches S1, S2 for the signal sets Sg1, Sg2, is established in the switching unit Sch.

FIGURE 1 shows in the last column of the storage cells I, II the switching command "L" and in the last column of storage cells III and IV the switching command "0." These different switching commands and the connection V14 could be dispensed with if the number of storage cells fed with information exactly correspond to the number of programmes handled, i.e., the two storage cells I and II storing switching commands only. In that case, however, the information content in the storage cells III and IV, which would not be operative at that particular moment, would have to be stored outside the storage device Sp, e.g. in the form of punched tape. This, however, would call for costly recording procedures, in the event of any need arising for switching from the programme of the storage cells I and II to the programme of storage cells III and IV. Thus, preferably the data included in either programme is stored in the storage device Sp and whatever programme is required at any given time is fed into the unit by inscribing the switching commands "L or 0" in cells I, II or III, IV. A connection V14 and the associated switch v14 are used for this purpose, in view of the fact that the information content of the individual storage cells III, IV, which are currently inactive, will cause switching commands to be transmitted to the connections V15 and V16 in the event of coincidence with the times indicated by the counters Zg1 to Zg3.

Thus, if for example the cell I, FIGURE 1, is sampled by the pulse distributor Tv through the address register $Ar_L$ then, via the connection V13, the counter Zg2 is connected to the comparator devices Vg1, Vg2. These upon coincidence between the time indicated by Zg2 and the information content 85 of the cell I and after the arrival of the switching command L through the connection V14, change the state of the bistable switch S1 in the signal set Sg1 via the connection V11, V15 and the setting winding u so that the GO signals operate. In the switching unit Sch, the switching operations to be initiated via the individual connections V10, V14 to V16 are symbolised by the switches v10, v14 to v16. Only when the appropriate storage cell produces the switching command L via the connection V14 is the STOP or GO lamp in the associated signal set Sg1 or Sg2 switched on or off. This switching is effected by one of the relays S1 or S2 after selection has been made by the rotary switch v10, via the contacts V14 to V16. Simultaneously with the triggering of the bistable switches S1 or S2, delay elements can be brought into operation so that, although not illustrated, transition phase warning lamps can be switched in and out intermediate the GO/STOP and STOP/GO changes.

To ensure that only one of the grouped storage cells I, III or II, IV allotted to a signal set Sg1 or Sg2 is operative at any one time, these cells must be driven and supplied with appropriate information via an input system E and a succeeding address register $Ar_E$ which serves for the input function. In the simplest case this input system can take the form of a set of push-buttons. If the input system E is also to be capable of programme modification, then of course any desired type of programming unit can be employed, for example, a pulse generator controlled by perforated cards, perforated tapes, magnetic tapes, or teleprinter controlled by punched tape. Finally, a data-processing system can be employed which can be controlled by vehicle-operated pulse generators as a function of the traffic situation and such a system can be used together with a recording input system, for example, teleprinter. In the latter instance, the teleprinter records all the input information and demands associated with the individual signal sets so that a continuous record is produced of the clock-time, date and signal state at the separate traffic intersections. When using a data processing system for input purposes, advantageous alternation of selectively different signal programmes is ensured by suitable programming. If the programming unit is to operate as a function of the traffic situation, then likewise the information elements stored by the cell associated with the programme must be modified with each change in the traffic situation by the data-processing system. Self-evidently, it is also possible, depending upon the traffic situation, to select pre-determined operating sequences from the storage device Sp and then to adapt signal operation to the prevailing traffic conditions.

What we claim is:

1. A traffic signal unit for programming the operation of a plurality of sets of traffic signals having lamps controlled by lamp switches, comprising a storage register having storage elements disposed in a plurality of groups which form respective storage cells for storing switching programmes for the lamps of the individual signal sets, a pulse generator, at least one pulse counter operatively connected to said generator for counting pulses from said pulse generator, means for effecting a sampling of each cell once between successive pulses from such pulse counter, a comparator operatively connected to such a cooperable pulse counter and said register for comparing the information in each sampled cell with the pulse count contained such cooperable pulse counter at the time when that cell is sampled, and means for transmitting a signal to control the actuation of lamp switches of the traffic signal sets when the pulse count applied to the comparator corresponds to the sampled information applied to the comparator.

2. A control unit according to claim 1, wherein a plu-

rality of pulse counters are provided which respectively count timing cycles of different predetermined numbers of pulses, and wherein each programme stored in the register includes instructions for selecting a particular one of said pulse counters.

3. A control unit according to claim **1**, wherein two comparator devices are provided one of which is associated with operation of the GO signal lamp while the other is associated with the STOP signal lamp, said comparators being respectively connectible to different storage elements of a storage cell correspondingly associated with the GO and STOP signal lamps of an individual signal set, and wherein the individual counters are connectible to the said comparators in accordance with the different operating timing cycles for the signal lamps stored in the storage cells via a direct connection between the storage register and counter switching arrangements.



4. A control unit according to claim **1**, wherein a plurality of different programmes are stored in respective cells of the register, each cell being capable of storing a command signal indicating that the programme stored therein is to be used, and means for inserting said command signals in said cells under the control of data supplied thereto.

**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,090,032 | 5/1963 | Shand | 340—41 |
| 3,300,775 | 1/1967 | Dowling | 340—41 |
| 3,302,169 | 1/1967 | Wetmore | 340—41 |
| 3,302,170 | 1/1967 | Jensen | 340—41 |


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