

[54] **CONVERTER FOR A TOLL
VERIFICATION SYSTEM**

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[57] **ABSTRACT**

A converter for use in cooperation with a ticket sensing means and toll recorder in a toll verification system. Means are provided for producing a plurality of pulsed signal sequences to actuate the toll recorder. A plurality of switch means are provided in which each switch means controls the emission of a specific pulsed signal sequence. Means are included for receiving first and second output signals from the ticket sensing means and converting said signals into at least one switching signal which actuates a selected switch means to permit the pulsed signal sequence controlled thereby to activate the toll recorder.

5 Claims, 3 Drawing Figures

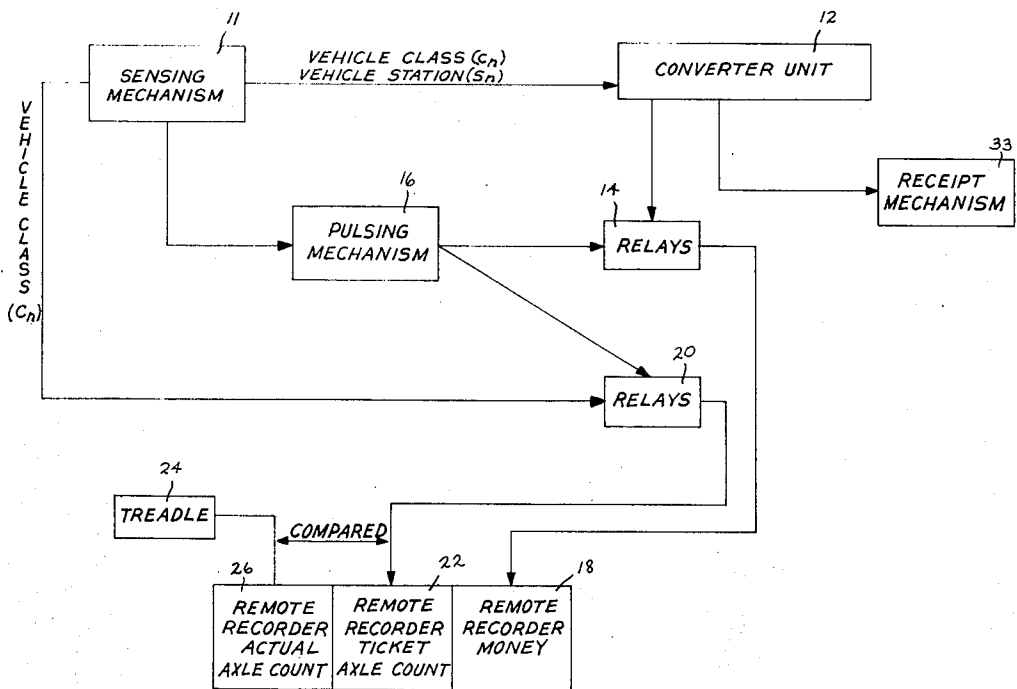
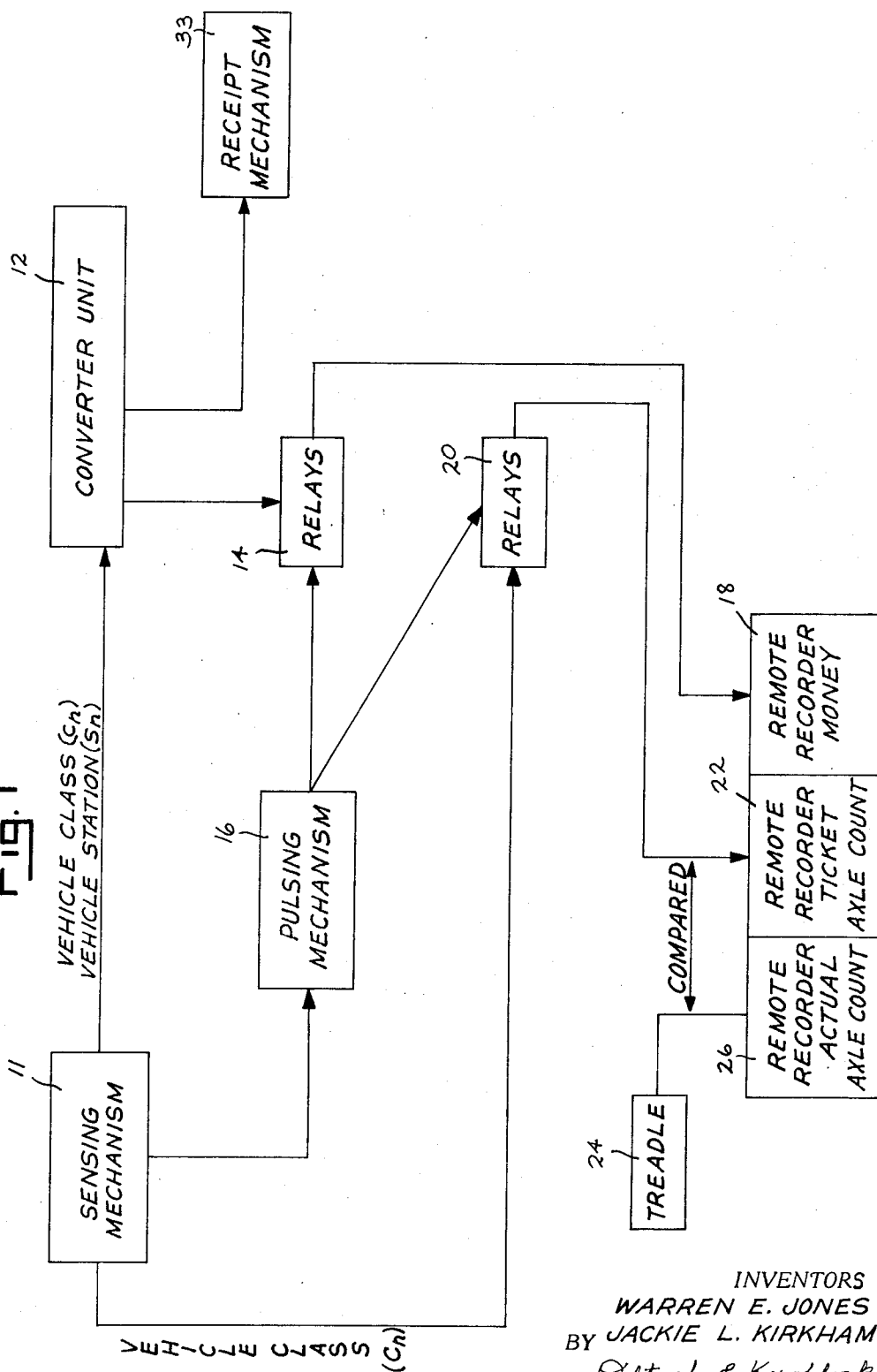


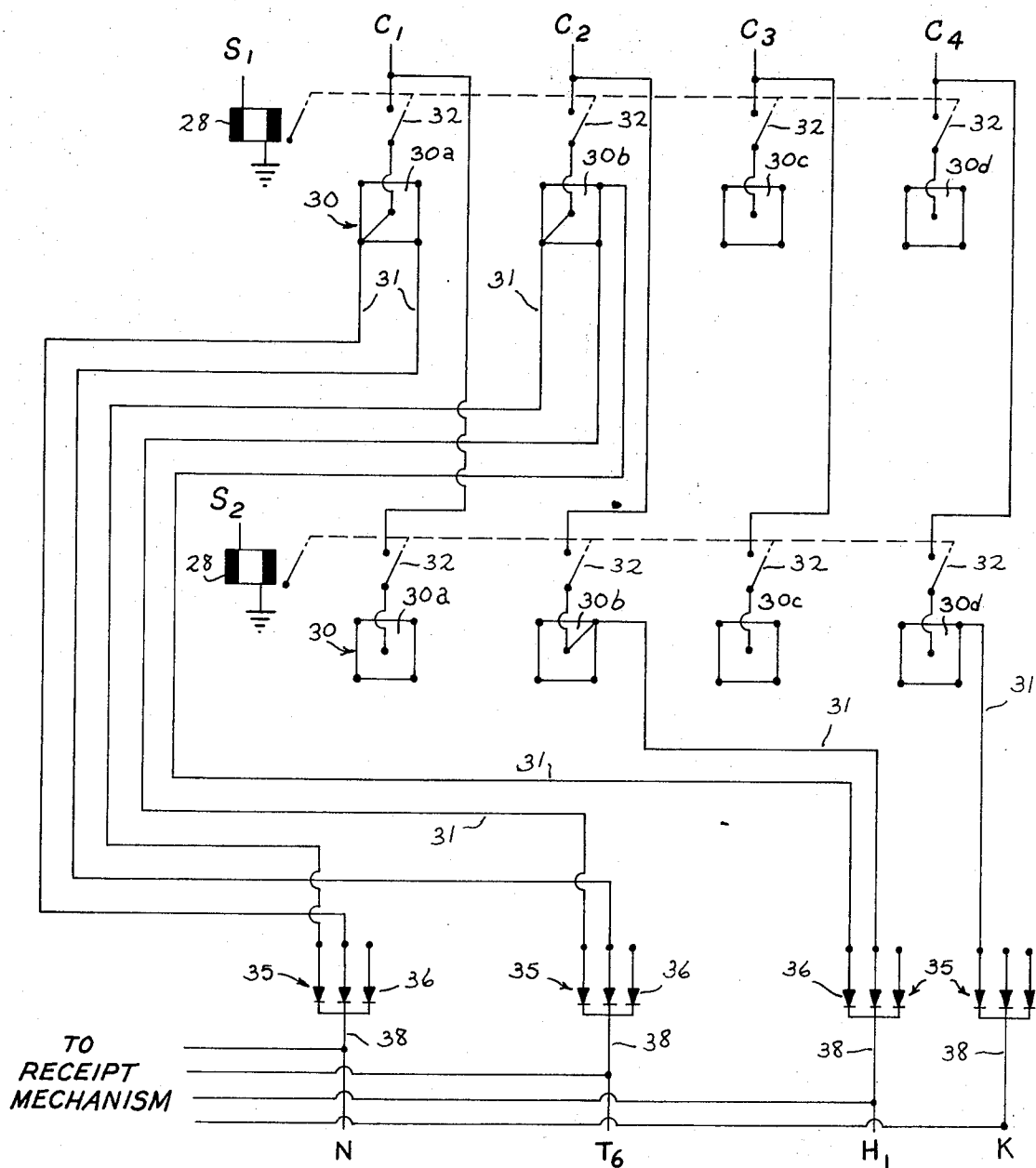
Fig. 1



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Fig. 2

CONVERTER UNIT



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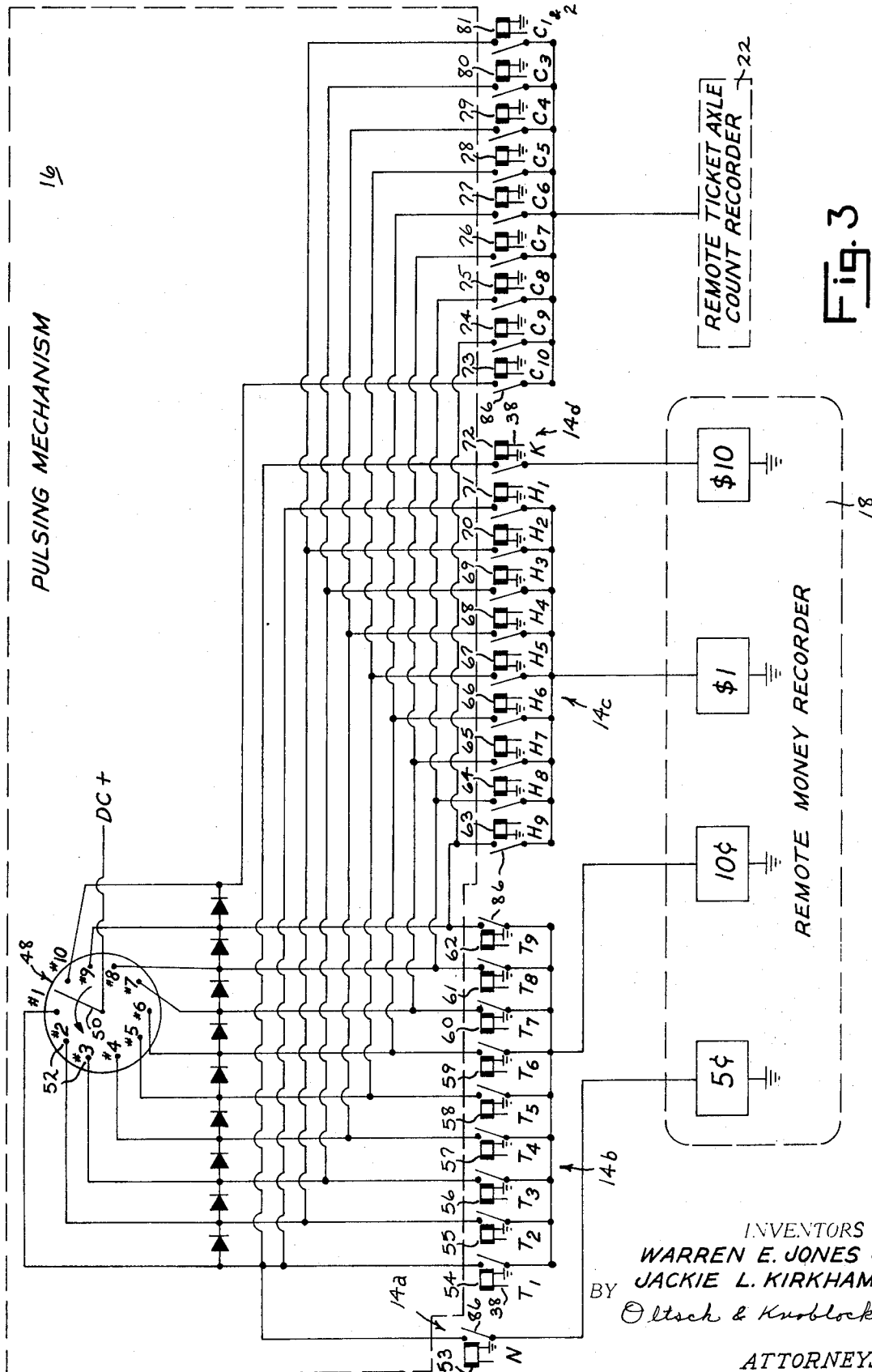


Fig. 3

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CONVERTER FOR A TOLL VERIFICATION SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to an improved toll verification system and specifically applies to a converter used within the toll verification system.

In nearly all toll systems it is necessary to provide means for verifying the toll receipts of the toll attendant. In toll systems, such as toll roads, having tolls or fares which vary from vehicle to vehicle according to the axle count of each vehicle, these verification systems have become quite complex, since not only the actual vehicle count but also the ticket fares must be compared with the toll receipts of the attendant.

In a typical toll road verification system, there is a ticket validator or sensing mechanism which obtains certain identifying information from the ticket of the toll road user and converts this information into a plurality of output signals. These output signals enter which is known as a fare selector which causes, in conjunction with a pulsing mechanism, the emission of electrical impulses which enter and cause activation of a remote money or toll recorder and a fare receipt mechanism which provides the toll user with a fare receipt. Additionally, the fare selector may cause activation of a remote ticket axle count recorder whose data is compared to the actual axle count of the vehicle as determined generally by a treadle system at the toll road exit. At the end of the toll booth attendant's work day, the cash count of the fares collected are compared with the totals of the remote toll recorder for the same period.

The fare selectors heretofore used in toll road verification systems contain a plurality of moving interengaging parts which are subject to wear and require constant maintenance. Additionally, each such fare selector utilizes an electrical motor as part of its actuating means, and it has been found exceedingly difficult and time consuming to synchronize such an electric motor with other coordinated motor drives utilized in the verification system. These maintenance factors increase the cost of running the toll road by requiring the employment of additional maintenance personnel and a large inventory of replacement components to minimize down time of the verification system.

In this invention, the mechanical fare selector is replaced by an electrical converter which substantially eliminates the maintenance factors associated with the fare selector.

SUMMARY OF THE INVENTION

This invention relates to a converter for use in a toll verification system. Means are provided for producing a plurality of pulsed signal sequences which cause actuation of a remote toll recorder. A plurality of switch means are associated with the means for producing pulsed signal sequences. Each switch means controls the emission of a specific pulsed signal sequence from the sequence producing means. Means are included for receiving first and second output signals from a toll ticket sensing means and converting said output signals into at least one switching signal which actuates a responsive switch means to permit the emission of a specific pulsed signal sequence for actuating the remote toll recorder.

The converter of this invention is so constructed that changes in tolls and in the number of toll combinations as a result of changes in the number of toll stations along the toll road can be accomplished with only a minimum of effort, time and expense. This converter is constructed essentially of electrical components and, as such, is nearly maintenance free.

Accordingly, it is an object of this invention to provide a means for use in a toll verification system which converts first and second toll indicating signals into electrical impulse sequences to cause actuation of a remote toll recorder in the system and which is of essentially maintenance free operation.

It is another object of this invention to provide means in a toll verification system for converting toll station and vehicle class signal data derived from a toll ticket into electrical signal sequences which are representative of the toll.

It is another object of this invention to provide an economical and rapid means for modifying a toll verification system to accommodate changes in toll rates.

Other objects of this invention will become apparent upon a reading of the invention's description.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention has been chosen for purposes of illustration and description wherein:

FIG. 1 is a block diagram of a toll verification system in which the converter of this invention is utilized.

FIG. 2 is a circuit diagram of the converter unit of the converter of this invention.

FIG. 3 is a combined circuit and schematic drawing of selected component parts of the toll verification system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment illustrated is not intended to be exhaustive or to limit the invention to the precise form disclosed. It is chosen and described in order to best explain the principles of the invention and its application and practical use to thereby enable others skilled in the art to best utilize the invention.

The toll verification system illustrated in FIG. 1 is of the type used in association with toll roads or turnpikes in which the road user is given a ticket upon his entry onto the toll road. This ticket includes information designating the point of entry of the vehicle onto the road, hereinafter referred to as the "vehicle station," and the class of vehicle which represents the vehicle size and which is generally determined in part by the number of axles the vehicle has. As the road user leaves the toll road, he presents his ticket to a toll booth attendant who in turn places the ticket in a validator or sensing mechanism 11. Sensing mechanism 11 may include a shiftable sensing head which is lowered down onto the ticket and which senses through pins, photoelectric components, or similar means the vehicle class and station data punched or otherwise recorded on the toll ticket and converts this information into first and second signals, designated for purposes of illustration C_n , representing any one of several vehicle classes, and S_n , representing any one of several vehicle stations. Sensing mechanism 11 may be one of any number of different types and constructions, such as the shiftable sensing head and index pin type used for a number of years on the Indiana Toll Road and manufactured by Taller & Cooper, Inc., Brooklyn, New York.

A converter unit 12, which is part of the converter of this invention and which will be later described in detail, receives signals S_n and C_n from mechanism 11 and converts the signals into at least one switching signal which energizes a responsive relay in a relay group 14 forming a part of the converter. Relay group 14 serves to interconnect a pulsing mechanism 16, which is also a part of the converter system and which will be later described in detail, with a remote money recorder 18. Pulsing mechanism 16 is activated by sensing mechanism 11 and serves to emit pulsed signal sequences which pass through relay group 14 and into remote money recorder 18. Additionally, pulsing mechanism 16, when activated by sensing mechanism 11, emits a pulsed signal sequence which passes through a relay group 20 and into a remote ticket axle count recorder 22.

Remote recorders 18 and 22 are responsive to the pulsed signal sequences of pulsing mechanism 16 and serve to produce a printed record of the toll or fare and ticket axle count. Each of these recorders may be one of any number of different types and constructions, such as the type used for a number of years on the Indiana Toll Road and manufactured by Taller & Cooper, Inc., Brooklyn, New York, in which coils are energized by each pulse of a pulsed signal sequence to actuate a pawl which in turn incrementally turns a wheel having associated numbered indicia about its circumference. Upon completion of the signal sequence, an ink ribbon and paper

tape are brought into contact with selected indicia on the wheel and a record of the transaction is recorded on the tape.

A treadle 24 is positioned in the roadway at the toll road exit and is connected to a remote actual axle count recorder 26. As the toll road user leaves the road, the wheels of his vehicle pass over treadle 24 causing the number of axles of the vehicle to be recorded by recorder 26 which functions much like recorders 18 and 22. By this means, the ticket axle count as recorded by recorder 22 can be compared to the actual axle count for each vehicle transaction. A receipt mechanism 33 may be connected to converter unit 12 to receive outputs therefrom in a manner later to be described so as to provide the toll road user with a receipt evidencing payment of the toll.

With the toll verification system generally described, a description of specific components of the converter of this invention and their method of operation will follow.

CONVERTER UNIT

Referring to FIG. 2, a converter unit 12 includes a plurality of relays 28 which are connected to sensing mechanism 11 and adapted to receive S_n signals therefrom. The number of relays 28 in converter unit 12 preferably equals the number of vehicle stations along the toll road with each relay 28 being energizable by a specific signal S_n which represents a certain vehicle station. Converter unit 12 also includes a plurality of junction means 30 which are grouped or divided into sets. The number of sets of junction means 30 preferably equals the number of vehicle classes in the toll system. In order to distinguish one set from another for purposes of description, all junction means 30 in one set are designated 30a, those junction means 30 in another set are designated 30b and so on. All junction means 30 in each set are joined or coupled to sensing mechanism 12 to receive in common a specific signal C_n therefrom. The number of junction means 30 in each set preferably equals the number of relays 28 in converter unit 12. As shown in FIG. 2, each relay 28 actuates a plurality of ganged normally open switch arms 32. The number of switch arms 32 ganged to a relay 28 equals the number of sets of junction means 30 and each switch arm thereof forms a part of the circuit between sensing mechanism 12 and a junction means 30 in each junction set and serves when in its normally open position to isolate the associated junction means from the sensing mechanism.

Converter unit 12 includes a plurality of diode groups 35 each comprising a plurality of individual diodes 36 poled as shown in FIG. 2 so as to direct the output therefrom into a common lead 38. Each junction means 30 is preferably of the multiple-terminal type with each terminal thereof adapted for connection by a jumper 31 to a diode 36 in a selected diode group 35. Jumpers 31 are preferably adapted for easy connection to and disconnection from the diodes 36 and the terminals of junction means 30. Each lead 38 of converter unit 12 may be connected to receipt mechanism 33 for energizing selected circuits therein to initiate the printing of a receipt. The construction and manner of operation of receipt mechanism 33 is well known in the art and such devices have been used for many years in various toll road systems.

RELAY GROUPS

Referring to FIG. 3, relay group 14 is divided into sections, hereinafter designated as relay sections 14a, 14b, 14c and 14d. Relay section 14a comprises a relay 53 which is connected to an appropriate lead 38 of converter unit 12 so as to receive energizing signal N. Relay section 14b preferably includes nine individual relays numbered 54 through 62 which are each connected to a lead 38 of converter unit 12 so as to receive a specific energizing signal T_n . Although only one T_n signal, that is T_6 , is illustratively shown in FIG. 2, it is to be understood that converter unit 12 will include a plurality of diode groups 35 and connecting leads 38 which correspond in number to the number of relays in relay section 14b and which are each

connected to an individual relay in the section so as to provide that relay with a specific energizing signal. Relay section 14c preferably includes nine individual relays numbered 63 through 71 which are each connected to a lead 38 of converter unit 12 so as to receive a specific energizing signal H_n . Again, although only one H_n signal, that is H_1 , is illustratively shown in FIG. 2, it is to be understood that the converter unit will include another plurality of diode groups 35 and connecting leads 38 which correspond in number to the number of relays in relay group 14c and which are each connected to an individual relay therein. Relay section 14d includes a relay 72 which is connected to an appropriate lead 38 of the converter unit so as to receive energizing signal K.

Relay group 20 includes a plurality of relays numbered 73 through 81 which are each connected to sensing mechanism 11 so as to receive a specific energizing signal C_n which, as previously mentioned, is derived from the class of the vehicle.

PULSING MECHANISM

Referring to FIG. 3, pulsing mechanism 16 includes a rotor assembly 48 having a rotatable motor driven arm 50 which is connected to a DC voltage source and which makes wiping contact with a plurality of circumferentially spaced contacts 52 as it revolves. Rotor assembly 48 is connected to the sensing mechanism 11 and is energized upon the insertion of the toll ticket within the sensing mechanism so as to cause arm 50 to make one revolution and wipe each contact 52 which are preferably 10 in number.

The first contact 52, designated as contact No. 1, to be wiped by arm 50 when rotor assembly 48 is energized is connected to the 5¢ indicator of remote money recorder 18 through relay 53 of relay section 14a, to the 10¢ indicator of the remote money recorder through parallel interconnecting relays 54-62 of relay section 14b, to the \$1 indicator of the remote money recorder through parallel interconnecting relays 63-71 of relay section 14c, to the \$10 indicator of the remote money recorder through relay 72 of relay section 14d, and to remote ticket axle count recorder 22 through parallel interconnecting relays 73-81 of relay group 20. Contact No. 2 of rotor assembly 48 is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 55-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-70 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-81 of relay group 20. Contact No. 3 of rotor assembly 48 is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 56-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-69 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-80 of relay group 20. Contact No. 4 of rotor assembly 48 is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 57-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-68 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-79 of relay group 20. Contact No. 5 of rotor assembly 48 is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 58-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-67 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-78 of relay group 20. Contact No. 6 of relay assembly 48 is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 59-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-66 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-77 of relay group 20. Contact No. 7 is connected to the 10¢ remote money recorder indicator through parallel intercon-

necting relays 60-62 of relay section 14b, to the \$1 remote money recorder indicator through parallel interconnecting relays 63-65 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-76. Contact No. 8 of the rotor assembly is connected to the 10¢ remote money recorder indicator through parallel interconnecting relays 61-62 of relay section 14b, to the \$1 remote money indicator through parallel interconnecting relays 63-64 of relay section 14c, and to the remote ticket axle count recorder through parallel interconnecting relays 73-75 of relay group 20. Contact No. 9 of the rotor assembly is connected to the 10¢ remote money recorder indicator through interconnecting relay 62 of relay section 14b, to the \$1 remote money recorder indicator through interconnecting relay 63 of relay section 14c, and to remote ticket axle count recorder through parallel interconnecting relays 73-74 of relay group 20. Contact No. 10 of the rotor assembly is connected to the remote ticket axle count recorder through interconnecting relay 73 of relay group 20.

Each relay of relay groups 14 and 20 includes a normally open switch arm 86 which serves in its open position to interrupt the connection between a contact 52 of the rotor assembly and corresponding remote recorder as shown in FIG. 3. Upon the energizing of a relay in relay groups 14 and 20, the switch arm associated therewith will close to place the contact 52 and recorder associated with that relay in electrical communication.

OPERATION OF THE TOLL VERIFICATION SYSTEM

For purposes of illustrating the operation of this invention in association with the toll verification system, it will be assumed that a vehicle approaches the toll booth at a selected toll road exit. As the toll road user is bringing his vehicle to a stop before the toll booth at the exit, the wheels of the vehicle pass over a treadle 24 in the roadway and actuate the remote actual axle count recorder 26 to record therein the number of axles of the vehicle. Once the vehicle is stopped, the toll road user hands his toll ticket to the toll booth attendant who in turn preferably inserts the ticket into sensing mechanism 11. As mentioned previously, the toll ticket contains information as to vehicle class and station or point of entry which is sensed by mechanism 11 and converted into voltage signals C_n and S_n. For purposes of illustration, it will be assumed that the toll ticket indicates the vehicle class to be number 2, or a two-axled passenger car, and the vehicle station to be number 1, or the first entrance onto the toll road. This information is converted by sensing mechanism 11 into output signals C₂ and S₁. Signal S₁ energizes an appropriate responsive relay 28 in converter unit 12 causing the normally open and ganged switch arms 32 connected thereto to close and to place those junction means 30 in association therewith in electrical communication with the sensing mechanism. Signal C₂ passes from the sensing mechanism into the junction means 30b placed in communication with the sensing mechanism by signal S₁. From the junction means 30b, signal C₂ passes into preselected diode groups 36 through interconnecting jumpers 31 and emerges therefrom as signals N₁, T₆, and H₁ which enter receipt mechanism 33 and cause, in a manner well known in the art, a print out of a toll receipt and a visual indication of the fare.

Signals N₁, T₆ and H₁ also energize relays 53, 59, and 71 respectively of relay group 14 to cause the closing of switch arms 86 associated therewith. Also, signal C₂ energizes relay 81 of relay group 20 to cause the closing of switch arm 86 associated with that relay. Sensing mechanism 11 now activates rotor assembly 48 of the pulsing mechanism to preferably initiate a circuit means, such as the energizing of holding coils commonly used in the art, to hold the switch arms of the energized relays of relay groups 14 and 20 closed and to cause arm 50 of the rotor assembly to make one revolution and contact each contact 52 once. Signals S₁ and C₂ may now terminate causing the energized relay 28 of converter unit 12 to be

responsively de-energized. All contacts 52 of the rotor assembly are consecutively wiped by arm 50 beginning with contact No. 1 and ending with contact No. 10, thus causing voltage pulses to pass through the circuit of the pulsing mechanism and, in association with relay groups 14 and 20, emerge therefrom as a pulsed signal sequence for causing actuation of remote money recorder 18 and remote ticket axle count recorder 22. Referring to FIG. 3, in one revolution of rotor assembly arm 50, one pulse will pass through relay 53 and into the 5¢ indicator of the remote money recorder to indicate a 5¢ portion of the total fare, six pulses will pass through relay 59 and into the 10¢ indicator of the remote money recorder to indicate a 60¢ portion of the total fare, one pulse will pass through relay 71 and into the \$1 indicator of the remote money recorder to indicate a \$1 portion of the total fare, thereby making a total fare of \$1.65, and two pulses will pass through relay 81 and into the remote ticket axle count recorder to indicate a two-axled vehicle. Thus, the fare, the axle count of the vehicle as shown on the toll ticket, and the axle count of the vehicle as determined by treadle 24 are recorded by remote recorders 18, 22 and 26 respectively and form a basis of verifying the receipts of the toll booth attendant at the close of his duty.

The entire process of inserting the toll ticket into the sensing mechanism and recording the toll and vehicle data takes at the most but a few seconds and does not delay the passage of traffic through the toll road exit. It is to be understood that a totally electronic pulsing device could be substituted for rotor assembly 48, thereby making the recording of the toll and vehicle data nearly simultaneous with the insertion of the toll ticket into the sensing mechanism. The number of relay sections in relay group 14 and the number of relays in each relay section and relay group 20 can vary depending upon the fare capacity of the remote money recorder and the number of combinations of axle counts for the various vehicles. Each relay in relay group 14 will preferably be connected to a separate diode group 36. Jumpers 31 will interconnect specific diode groups 36 with junction means 30 in determining various fare combinations between the exit and other entrances onto the toll road and are preferably readily detachable from and re-attachable to the diodes and junction means so as to permit changes in fares to be made in a rapid and simple manner.

What we claim is:

1. A converter for use in a toll verification system which includes a ticket sensing means and a money recorder means, said converter comprising means for producing a plurality of first pulsed signal sequences to actuate said money recorder means, a plurality of first switch means in association with said signal sequence producing means, each first switch means controlling the transmission of a first pulsed signal sequence from said signal sequence producing means to said money recorder means, means for receiving first and second signals from said ticket sensing means and converting said first and second signals into at least one switching signal for actuating one of said first switch means to permit the emission of the pulsed signal sequence controlled thereby, said means for receiving said first and second signals from said ticket sensing means including a plurality of second switch means and a plurality of junction means sets, one of said junction means sets being adapted to receive said first signal and including a plurality of junction means, one of said second switch means being responsive to said second signal and controlling the transmission of said first signal into a specific junction means of said first signal receiving junction means set, and a plurality of diode groups each including at least one diode associated with a said first switch means and each poled to direct a signal received thereby into its diode-associated first switch means, and means connecting said specific junction means to a selected diode in one of said diode groups for directing said first signal from said specific junction means to said one diode group.

2. The converter of claim 1 wherein said connecting means is a jumper having one end part releasably connected to said specific junction means and the other end part releasably connected to said selected diode.

3. The converter of claim 2 wherein said specific junction means is of the multiple-terminal type and said jumper has one end part releasably connected to a terminal thereof.

4. A converter for use in a toll verification system which includes a ticket sensing means and a money recorder means, said converter comprising means for producing a plurality of first pulsed signal sequences to actuate said money recorder means, a plurality of first switch means in association with said signal sequence producing means, each first switch means controlling the transmission of a first pulsed signal sequence from said signal sequence producing means to said money recorder means, and means for receiving first and second signals from said ticket sensing means and converting said first and second signals into at least one switching signal for actuating one of said first switch means to permit the emission of the pulsed signal sequence controlled thereby, said signal sequence producing means including the function of producing a plurality of second pulsed signal sequences adapted to actuate an axle count recorder in said toll verification system, a plurality of second switch means in association with said signal sequence producing means, each second switch means controlling the transmission of a second pulsed signal sequence from said signal sequence producing means to said axle count recorder and being responsive to one of said first

and second signals from said ticket sensing means so as to permit the emission of the pulsed signal sequence controlled thereby.

5. A converter for use in a toll verification system which includes a ticket sensing means and a money recorder means, said converter comprising means for producing a plurality of first pulsed signal sequences to actuate said money recorder means, a plurality of first switch means in association with said signal sequence producing means, each first switch means controlling the transmission of a first pulsed signal sequence from said signal sequence producing means to said money recorder means, means for receiving first and second signals from said ticket sensing means and converting said first and second signals into at least one switching signal for actuating one of said first switch means to permit the emission of pulsed signal sequence controlled thereby, said means for receiving said first and second signals from said ticket sensing means including a plurality of second switch means and a plurality of junction means sets, one of said junction means sets being adapted to receive said first signal and including a plurality of junction means, one of said second switch means being responsive to said second signal and controlling the transmission of said first signal into a specific junction means of said first signal receiving junction means set, and means connecting said specific junction means to one of said first switch means.

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