

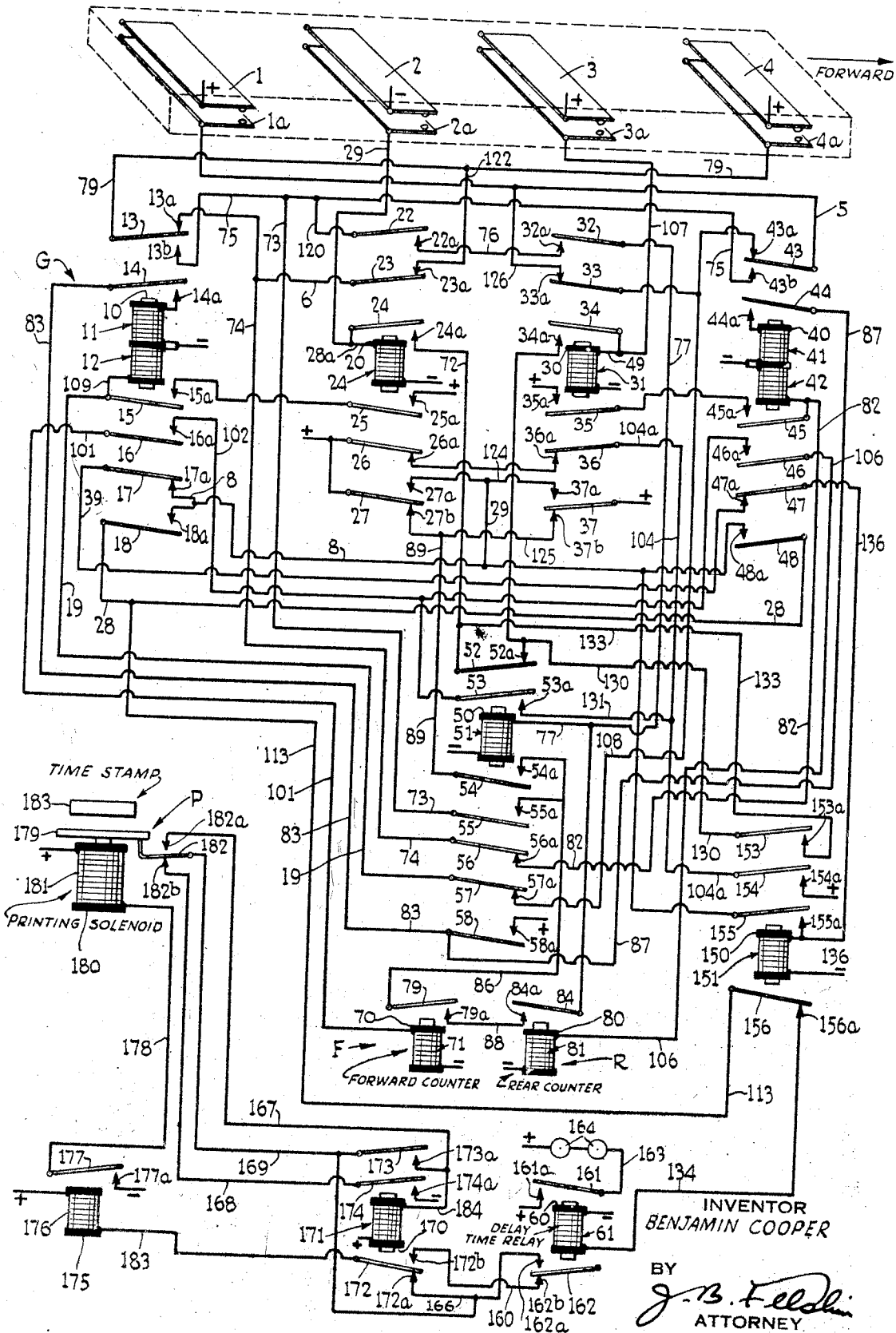
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TREADLE CONTROLLED TOLL CHECKING SYSTEM

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TREADLE CONTROLLED TOLL CHECKING SYSTEM

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This invention relates to a treadle-controlled toll checking system.

In toll checking systems it is imperative to obtain an accurate count of vehicles passing the point of toll collection. In such a system employing a multi-switch treadle to count the axles of vehicles passing over the treadle, false counts may be obtained by shorting of one or more of the switches, as a result of tampering, or by placing a weight on the treadle. It is, therefore, an object of this invention to provide, in a counting system of the character described, controlled by a vehicle actuated multi-switch treadle, means to count the axles of vehicles even if a switch or certain selected switches are shorted, whereby a true count is obtained notwithstanding tampering with the treadle, as described above.

A still further object of this invention is to provide in a counting system of the character described employing a four switch treadle, means to count the axles of cars passing over the treadle, even if both the middle switches are shorted; or one or both of the middle switches, and thereafter one of the outside switches are shorted, or if the two outside switches are shorted.

Yet a further object of this invention is to provide a toll checking system of the character described, having two electric counters and a four switch treadle, and means to count axles of vehicles on one of the counters when the wheels of the vehicle roll over the treadle in one direction, and means to count axles of vehicles on the other counter when the wheels of vehicles roll over the treadle in an opposite direction, the system being such as to count the axles on the proper counter responsive to direction of movement of the vehicles, even if one or the other or both of the two outside switches are shorted.

Still a further object of this invention is to provide in a toll checking system of the character described, employing a treadle having four switches adapted to be actuated by the wheels of vehicles passing over the treadle, and means to count the axles of vehicles passing over the treadle, signal means adapted to be actuated when either the first or the last switch is first closed or shorted, and then one or both of the middle switches are closed for longer than a predetermined period, said system being then inoperative to count vehicles passing over the treadle, and means being further provided to record the time when said middle switch or

switches have been closed longer than said predetermined time, to render the system inoperative, to count vehicles, and also to record the time when either the closed middle switch or switches has opened to again render the system operative to count axles of vehicles passing over the treadle.

Still another object of this invention is to provide a durable system of the character described, which shall be relatively inexpensive to manufacture, positive in operation, and practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out. The invention accordingly consists in the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of this application will be indicated in the following claims.

In the accompanying drawing, in which is shown one of the various possible embodiments of this invention,

The single figure of the drawing is a diagrammatic representation of a system embodying the invention.

Referring now in detail to the drawing, 9 designates a treadle embedded in a roadway, transversely thereof, and adapted to be traversed by vehicles passing over the roadway. Mounted in the treadle 9 are a plurality of pairs of elongated parallel contacts 1, 1A; 2, 2A; 3, 3A and 4, 4A. Said pairs of contacts constitute switches normally open but which may be successively closed and opened as the wheels of a vehicle roll over the treadle. The contacts 1, 2, 3 and 4 are connected to the plus side of an electric power supply. Preferably, the switches are spaced apart not more than three inches so that as the front and rear wheels of a vehicle roll over the treadle, the switches will be closed successively and adjacent switches will be concurrently closed.

The switches are connected by a circuit C so arranged, as will appear hereinafter, that the operation of the treadle in the direction indicated on the drawing, from left to right, will actuate a counter F termed the forward counter, while the wheels of a vehicle rolling over the treadle in the opposite direction will actuate a second counter R, termed the rearward counter.

The forward counter F comprises a relay 70 having a coil 71, one side of which is connected to the minus power supply. Said relay 70, when energized, is adapted to open a switch arm 79,

which is normally in engagement with a fixed contact 78a.

The rearward counter R comprises a relay 80 having a coil 81, one end of which is connected to the minus power supply. Said relay, when energized, is adapted to open a switch arm 84 which is normally in engagement with a fixed contact 84a.

The circuit C comprises four relays designated by numerals 10, 20, 30 and 40. Relay 10 has two windings 11 and 12 connected together and to a minus power supply. Associated with relay 10 are movable switch arms 13, 14, 15, 16 and 18. Switch arm 13 is normally in engagement with a fixed contact 13a and is adapted to be moved by the relay 10 into engagement with a fixed contact 13b. The switch arm 14 is normally open, and is adapted to be moved by the relay 10 into engagement with a fixed contact 14a. Switch arms 15, 16 and 18 are normally open, but are adapted to be moved by the relay 10 into engagement with fixed contacts 15a, 16a and 18a, respectively.

Relay 20 is provided with a coil 21 connected at one end to a minus power supply. Associated with said relay are switch arms 22, 23, 24, 25, 26 and 27. Switch arms 22, 24, 25 are normally open and are adapted to be moved by the relay 20 into engagement with fixed contacts 22a, 24a and 25a, respectively. Switch arm 23 normally engages a fixed contact 23a and is adapted to be opened by the relay 20. Switch arm 26 is normally in engagement with a fixed contact 26a, but is adapted to be opened by the relay 20. Switch arm 27 is normally in engagement with a fixed contact 27b but is adapted to be moved by the relay 20 out of engagement with respect to said fixed contact 27b, and into engagement with another fixed contact 27a.

Relay 30 is provided with a coil 31 connected at one end to the minus power supply. Said relay controls switch arms 32, 33, 34, 35, 36 and 37. Switch arms 32, 34, and 35 are normally open but are adapted to be moved by said relay into engagement with fixed contacts 32a, 34a and 35a, respectively. Switch arm 33 is normally in engagement with a fixed contact 33a and is adapted to be opened by said relay 30. Switch arm 36 is normally in engagement with a fixed contact 36a and is adapted to be opened by the relay 30. Switch arm 37 is normally in engagement with a fixed contact 37b but is adapted to be moved out of engagement with respect thereto, and into engagement with another fixed contact 37a, upon energizing said relay 30.

Relay 40 has two coils 41 and 42. Said coils are interconnected at adjacent ends and connected to the minus power supply. Associated with the relay 40 are switch arms 43, 44, 45, 46 and 48. Switch arms 44, 45, 46 and 48 are normally open but are adapted to be moved by said relay into engagement with fixed contacts 44a, 45a, 46a and 48a. Switch arm 43 is normally in engagement with a fixed contact 43a but is adapted to be moved by said relay out of engagement with respect thereto, and into engagement with another fixed contact 43b.

Said circuit C further comprises a relay 50 provided with a coil 51, one end of which is connected to the minus power supply. Associated with the relay 50 are switch arms 52, 53, 54, 55, 56, 57 and 58. Switch arms 53, 54, 55 and 58 are normally open and are adapted to be moved by said relay into engagement with fixed contacts 53a, 54a, 55a and 58a, respectively. Switch

arm 52 normally contacts fixed contact 52a but is adapted to be opened by relay 50. Switch arms 56 and 57 normally engage fixed contacts 56a and 57a, respectively, and are adapted to be opened by the relay when the latter is energized.

Contact 1a is connected by wire 5 to the switch arm 43 and by wire 126 to the fixed contact 33a. Contact 2a is connected by wire 29 to switch arm 24 and by wire 28a to the coil 21. Contact 3a is connected by wire 107 to the switch arm 34 and by wire 49 to the coil 31. Contact 4a is connected by wire 79 to the switch arm 13 and by wire 122 to the fixed contact 23a. Fixed contact 13a is connected by wire 74 to the switch arm 56 and by wire 6 to the switch arm 23.

Fixed contact 13b is connected by wire 75 to the fixed contact 43b and by wire 73 to the switch arm 55, and also by wire 120 to the switch arm 22. Fixed contact 14a is connected by wire 110 to the coil 11. Fixed contact 15a is connected by wire 7 to the switch arm 25. Switch arm 15 is connected by wire 109 to the coil 12 and by wire 19 to the switch arm 57. Fixed contact 16a is connected by wire 102 to fixed contact 46a and by wire 103 to the switch arm 53. Switch arm 16 is connected by wire 101 to coil 71 of the forward counter F. Fixed contact 18a is connected by wire 8 to the fixed contact 48a and by wires 29 and 124 to fixed contacts 27a and 37a. Switch arm 18 is connected by wire 28 to switch arm 48.

Fixed contact 22a is connected by wire 76 to the fixed contact 32a. Fixed contact 24a is connected by wire 72 to the switch arm 52. Fixed contact 25a is connected to the plus power supply. Switch arm 26 is connected to plus power supply and by wire 38 to switch arm 27. Fixed contact 26a is connected by wire 100 to the fixed contact 36a. Fixed contact 27b is connected by wire 125 to fixed contact 37b and by wire 89 to switch arm 54. Switch arm 32 is connected by wire 77 to one side of the coil 51 and by wire 85 to the switch arm 84. Switch arm 33 is connected by wire 128 to the fixed contact 43a and by wire 108 to the fixed contact 57a. Fixed contact 34a is connected by wire 59 to fixed contact 52a. Fixed contact 35a is connected to the plus power supply. Switch arm 35 is connected by wire 129 to the fixed contact 45a. Switch arm 36 is connected by wires 104 and 131 to the fixed contact 53a. Switch arm 37 is connected to the plus power supply. Switch arm 44 is connected by wire 87 with switch arm 58. Fixed contact 44a is connected by wire 135 to coil 41. Coil 42 is connected by wire 137 to the switch arm 45 and by wire 82 to the fixed contact 56a. Switch arm 46 is connected by wire 106 with coil 81 of counter relay 80.

Fixed contact 54a is connected by wire 86 to switch arm 79 and by wire 121 to the fixed contact 55a. Fixed contact 58a is connected to the plus power supply. Fixed contacts 78a and 84a are interconnected by a wire 88.

When the wheels of a vehicle roll over treadle 9 from left to right, in the direction indicated in the drawing, switch 1, 1A will first close energizing relay 10 through coil 12 thereof. The completed circuit is from the plus side of a source of potential through switch 1, 1A, wire 5, switch 43, 43a, wire 108, switch 57, 57a, wire 19, wire 109, and the coil 12, to the minus side of a source of potential. The energizing circuit for said relay may also be traced through switch 1, 1a, wires 5 and 126, closed switch 33, 33a, through wire 128,

and thence through wire 100, as before. The energized relay 10 will then close the switches 13, 13b; 14, 14a; 15, 15a; 16, 16a and 18, 18a, and open switch 13, 13a.

When switch 2, 2A is thereafter closed by the wheels of a vehicle, while switch 1, 1A is still closed, relay 20 will be energized by the completed circuit through switch 2, 2A, wires 29 and 28a, and coil 21. Switches 22, 22a; 24, 24a; 27, 27a and 25, 25a now close and switches 23, 23a; 26, 26a and 27, 27b now open. Holding circuit will now be completed through coil 12 energizing the relay 10 and keeping the said relay energized after switch 1, 1A of treadle 9 has been opened. This circuit is through switch 25, 25a, wire 7, switch 15, 15a, wire 109 and coil 12, to the minus side of an electrical power supply.

Following through the motion of the wheels over the treadle 9, switch 1, 1A will open and switch 3, 3A will be closed while switch 2, 2A is still closed. In closing switch 3, 3A, relay 30 will be energized by the circuit from the plus side of a source of electric power through switch 3, 3A, wires 107 and 49, and the coil 31 of relay 30 to the minus side of a source of electric power. Energization of relay 30 closes switches 32, 32a; 34, 34a; 35, 35a and 37, 37a, and opens switches 33, 33a; 36, 36a and 37, 37b.

In closing switch 3, 3A, and by action of the energized relay 30, a circuit is completed to hold relay 20 energized even if switch 2, 2A is opened. The completed circuit is through switch 3, 3A, wire 107, switch 34, 34a, wire 59, switch 52, 52a, wire 72, switch 24, 24a, wire 28a and coil 21 of the relay 20.

Still following the passage of the wheels over the treadle 9 in the direction indicated on the drawing, switch 4, 4A will close and switch 2, 2A will open while switch 3, 3A is still closed.

Closing switch 4, 4A will provide a circuit energizing relay 50, the circuit being through coil 51 of relay 50, wire 77, switch 32, 32a, wire 76, switch 22, 22a, wires 120 and 75, switch 13, 13b, wire 79 and switch 4, 4A. Energizing relay 50 will close switches 53, 53a; 54, 54a; 55, 55a and 58, 58a, and will open switches 52, 52a; 56, 56a and 57, 57a. By closing switch 55, 55a, another energizing circuit for relay 50 is completed, the purpose of which will be hereinafter apparent. This second circuit may be traced from minus power supply, through coil 51 of said relay, wires 77 and 85, switch 84, 84a, wire 88, switch 79, 79a, wires 86 and 121, switch 55, 55a, wires 73 and 75, switch 13, 13b (the relay 10 being energized) wire 79, through closed switch 4, 4a, to plus power supply. In closing switch 58, 58a another circuit will be completed holding the relay 10 energized through coil 11 of said relay, the circuit being through switch 58, 58a, wire 83, switch 14, 14a; wire 110 and coil 11.

Opening switch 52, 52a will break the previously described circuit holding relay 20 energized through switch 3, 3A. Switch 2, 2A has also been opened by the wheel rolling off the lane, breaking the circuit through said switch and coil 21 of relay 20. Relay 20 is then de-energized. De-energization of relay 20 will allow switches 23, 23a; 26, 26a and 27, 27a to close, will allow switches 22, 22a; 24, 24a; 25, 25a and 27, 27a to open.

De-energization of relay 20 serves to complete a holding circuit for relay 50 in its energized condition, for the purpose hereinafter appearing. The second circuit for relay 50 holds said relay energized while switch 22, 22a opens upon

de-energizing relay 20. This holding circuit is from the negative side of a source of electrical energy, through coil 51 of relay 50, wires 77 and 85, switch 84, 84a, wire 88, switch 79, 79a, wire 86, switch 54, 54a, wire 89, switch 27, 27b, and through wire 38 to the positive side of a source of electrical energy.

The further progression of the wheels over the treadle 9 will open switch 3, 3A de-energizing relay 30. Switches 33, 33a; 36, 36a and 37, 37b will then close, and switches 32, 32a; 34, 34a; 35, 35a and 37, 37a will then open. Opening of switch 3, 3A will energize the directional forward counter F, the completed circuit being through coil 71 of counter relay 70, wire 101, switch 16, 16a, wires 102 and 103, switch 53, 53a, wires 131 and 104, switch 36, 36a, wire 100, and switch 26, 26a. Counter relay 70 will then register one count on the counter F. The actuation of counter F will open switch 79, 79a and hence break the holding circuit for relay 50 through said switch. It will now be noted that relay 50 was held in energized condition until counter F was actuated irrespective of the condition of the last two treadle switches 3, 3A; 4, 4A to insure a count even if the wheels pass over the treadle at a great rate of speed. De-energized relay 50 will allow switch 58, 58a to open, opening the circuit of coil 11 of relay 10, thereby de-energizing relay 10. All the switches of the treadle are then opened and all relays are de-energized.

The operation of the circuit as described will be similar were all the steps in the operation of the circuit taken in the reverse order. The closing of switches in the sequence 4, 4A; 4, 4A and 3, 3A; 3, 3A and 2, 2A; 2, 2A and 1, 1A; and 1, 1A, will operate the backward counter R.

It will now be understood, from the operation of this invention, that the closure of the switches in the order of 1, 1A and 2, 2A or 4, 4A and 3, 3A will determine the directional counter to be actuated.

By first closing treadle contacts 1, 1A; 2, 2A, the backward counter R is locked out to prevent count on the wrong counter. To actuate counter R, relay 40 must be energized. But by energizing relays 10 and 20 before closing switch 4, 4A, relay 40 cannot be energized because by energizing relay 10, switch 13, 13a is opened and by energizing relay 20, switch 23, 23a is opened. Thus, the two circuits for energizing relay 40 through switches 13, 13a and 23, 23a are thereby opened. Even if the wheel rolls off contact 2, 2A, counter R will nevertheless remain locked out for the following reasons. The closing of treadle switch 4, 4A has completed the circuit through the relay 50. The closing of the circuit through the relay 50 has opened one of the circuits through the relay 20. The opening of the other circuit through the relay 20 by the wheel rolling off contact 2A as it proceeds from left to right on the treadle de-energizes said relay allowing switch 23, 23a to close. However, the energization of relay 50 has opened switch 56, 56a before closure of switch 23, 23a, keeping the circuit through said switch open.

Taking the reverse steps in closing switches 4, 4A and 3, 3A, counter relay 70 will be locked out.

In previous counting systems controlled by multi-switch vehicle actuated treadles, false counts may be obtained by shorting one or more of the switches as a result of tampering therewith, or by placing a weight on the treadles. Means is therefore provided to count the axles of vehicles passing over the treadle in either direc-

tion if any one of the switches is shorted, whether it be the first switch 1, 1A; or the inner switches 2, 2A or 3, 3A, or the last switch 4, 4A; and to count the axles passing over the treadle even if both of the inner or middle switches 2, 2A and 3, 3A are shorted, or one or both of the inner or middle switches are shorted, and thereafter one of the outside switches 1, 1A or 2, 2A is shorted, or if only the two outside switches are shorted.

To this end, there is further provided a relay 150 having a coil 151 connected at one end to the minus power supply. Associated with said relay are switch arms 153, 154 and 155. Said switches are normally open but are adapted to be moved into engagement with fixed contacts 153a, 154a and 155a, respectively, when the relay 150 is energized. There is further provided a switch arm 17, controlled by the relay 10, normally in engagement with a fixed contact 17a, but adapted to be opened when said relay is energized. There is also provided a switch arm 47, controlled by the relay 40, normally in engagement with a fixed contact 47a, but adapted to be opened when said relay is energized. Fixed contact 47a is connected to switch arm 17 by wire 39 and fixed contact 17a is connected by wire 8 to the fixed contact 18a. Switch arm 47 is connected by wire 136 to the fixed contact 155a and to the coil 151. Switch arm 153 is connected by wire 130 to the fixed contact 52a. Fixed contact 153a is connected by wire 133 to the switch arm 52. Switch arm 154 is connected by wire 104a to the wires 104 and 131 and hence to the switch arm 36, and to the fixed contact 53a. Fixed contact 154a is connected to the plus power supply. Switch arm 155 is connected by wire 132 to wire 8 and hence to the fixed contacts 48a, 17a and 18a.

Assume, therefore, that switch 1, 1A of treadle 9 has been closed by tampering, or shorted in any manner. By shorting switch 1, 1A, relay 10 will be energized and remain energized throughout the entire operation of the counter. This device will be operated in the same manner as hereinbefore described, the axle count being registered on the proper directional counter. Relay 10 will not be deenergized, however, at the end of the counting operation. The wheels of a vehicle rolling over treadle 9 in the opposite direction than that indicated will actuate switches 4, 4A and 3, 3A to de-energize relay 10 so that counter R is operated in the normal manner as the wheels continue rolling across the treadle. The closing of switches 4, 4A and 3, 3A energizes relays 40 and 30, respectively, to open both circuits for coil 12 of relay 10.

In the event that treadle switch 4, 4A is shorted, relay 40 will remain energized during the counting operation in the same manner as when switch 1, 1A was shorted and relay 10 remained energized. Vehicle axles passing over the treadle will likewise register directional counts on the counters R and F, as described above.

Assuming now that treadle switch 2, 2A is shorted, the wheels of the first axle passing over the treadle will be registered on either counter F or counter R, depending upon direction of movement, and wheels of axles subsequently passing over the treadle in either direction, will register on the counter which registered the first count after shorting said treadle switch.

Upon shorting of switch 2, 2A, relay 20 will be energized in the manner heretofore described. By the action of energized relay 20, switch 27,

27a will close completing a circuit through the coil 151 of relay 150. The completed circuit is through the coil 151, wire 136, switch 47, 47a, wire 39, switch 17, 17a, wires 8 and 29, switch 27, 27a and wire 38. Energizing relay 150 will close the switches 153, 153a; 154, 154a and 155, 155a. Another, or holding circuit is then completed to hold relay 150 energized through the coil 151, switch 155, 155a, wires 132, 8 and 29, switch 27, 27a and wire 38. Switch 17, 17a may then open when actuated by relay 10, leaving relay 150 still energized by the latter circuit.

As the wheels of a vehicle roll over the treadle 9, in the direction indicated, relay 10 will be energized. Switch 2, 2A being shorted, relay 10 will again be held energized by the circuit through switch 25, 25a, wire 7, switch 15, 15a, wire 109 and coil 12.

The closing of the switches 3, 3a and 4, 4a by the wheels of a vehicle will again set up the circuits as hereinbefore described energizing relay 50. Relay 20, being energized due to the shorted condition of switch 2, 2A, will hold switch 26, 26a open. The circuit through switches 26, 26a and 36, 36a hereinbefore described to actuate the counter relay 70 is therefore open. Switch 154, 154a, however, is closed due to action of energized relay 150 and switch 53, 53a is closed due to action of relay 50. Counter relay 70 is then energized by the circuit through coil 71, wire 101, switch 10, 10a, wire 102, wire 103, switch 53, 53a, wire 131, wire 104a, and switch 154, 154a. The operation of counter relay 70 will open the circuit, holding relay 50 energized. De-energizing relay 50 will open switch 53, 53a thereby de-energizing counter relay 70.

It will now be understood that relays 10, 20, 30 and 150 remain energized after the first count on counter F. As vehicles continue moving over the treadle in either direction, each time treadle switch 4, 4A is closed, the same counter F will register subsequent counts. The provision of switch 153, 153a connected in parallel across switch 52, 52a prevents more than one count each time wheels on an axle pass over the treadle after the first count which establishes the counter to take the counts.

If relay 30 were permitted to become de-energized during the operation of the counter, as above described, a double count would result on all wheels of axles passing in an opposite direction over the treadle, subsequent to the wheels of the first axle passing over its treadle in said opposite direction. Switch 153, 153a, however, prevents de-energization of said relay, as will now be explained.

Assuming that switch 153, 153a is not in the circuit and switch 2, 2A of the treadle is shorted energizing relay 20, the wheels of a vehicle rolling over the treadle in the direction indicated will actuate the counter F. In actuating counter relay 70 of counter F, relay 50 would first be energized, and thereafter de-energized by action of counter 70. By energizing relay 50, switch 52, 52a will open, permitting relay 30 to be de-energized.

The front wheels of a vehicle rolling over the treadle 9 in the opposite direction than that indicated, would close switches 4, 4A and 3, 3A operating the counter F as herein described. In allowing switch 4, 4A to open, relay 50 will be de-energized, closing switch 52, 52a. Switch 3, 3A still being closed by the wheel, will hold relay 30 energized at the same time switch 52, 52a is

again closing. Before switch 3, 3a is opened, switch 52, 52a has closed, completing a circuit to hold relay 30 energized after switch 3, 3a is open. The circuit holding relay 30 energized is through the coil 31 of relay 30, wire 48, switch 34, 34a, wire 59, switch 52, 52a, wire 72, switch 24, 24a, wire 29, and shorted switch 2, 2A. Relays 10, 20 and 30 are therefore left energized after the counting operation of the front axle.

The rear wheels of the vehicle in rolling over the treadle will close the switch 4, 4A. Closing switch 4, 4A will energize relay 50 opening switch 52, 52a and closing switch 53, 53a. Closing switch 53, 53a will energize the counter relay 70. Opening switch 52, 52a will de-energize relay 30. Relay 50 is then de-energized by action of counter relay 70 on switch 70, 70a and by the action of relay 30 opening switch 32, 32a. As the rear wheels of the vehicle then roll onto the treadle 9, switch 3, 3a will then be closed. Relay 30 is thereby energized and switch 4, 4A still held closed by the rear wheels, will energize relay 50 once more, the circuit being through switches 4, 4A; 13, 13b; 22, 22a and 32, 32a. Switch 53, 53a closes and the counter relay 70 is actuated for the second time for the same axle. By connecting switch 153, 153a in parallel with switch 52, 52a, a double count such as described is avoided. Switch 153, 153a is closed during the entire time that switch 2, 2A is shorted. As will hereinafter appear, switch 153, 153a will also remain closed during a shorted condition of switch 3, 3A of the treadle 9 and for the similar purpose of preventing a double count for one axle.

Assume that treadle switch 3, 3A of treadle 9 is now shorted, the wheels of the first axle passing over the treadle will register on either counter F or counter R, depending upon the direction of movement, and wheels of axles subsequently passing over the treadle in either direction will register on the counter which registered the first count after shorting said treadle switch. Switch 3, 3A being shorted, relay 30 will be energized closing switches 32, 32a; 34, 34a; 35, 35a and 37, 37a, and opening switches 33, 33a; 36, 36a and 37, 37b. Relay 150 is then energized by the circuit through the coil 151, wire 130, switch 47, 47a, wire 39, switch 17, 17a, wires 8, 20 and 124, and switch 37, 37a. Energizing relay 150 will close the switches 153, 153a; 154, 154a; and 155, 155a. A holding circuit for relay 150 is thereby completed through the switch 155, 155a, wires 132, 8, 20 and 124, and switch 37, 37a.

The wheels of a vehicle rolling over the treadle 9 will close the switches 1, 1a and 2, 2a. Relays 10 and 20 are energized closing their respective switches. Switches 15, 15a and 25, 25a complete the previously described circuit for holding relay 10 energized. Closed switch 24, 24a completes a circuit for holding relay 20 energized by action of energized relay 30, the circuit being through coil 21, wire 28a, switch 24, 24a, wires 72 and 133, switch 153, 153a, wires 130 and 59, switch 34, 34a, wire 107, and switch 3, 3a.

Switch 3, 3A being shorted, switch 4, 4A is now closed and switches 1, 1a and then 2, 2A allowed to open. Relays 10, 20 and 30 remain energized. Closing switch 4, 4A will energize relay 50. Energized relay 50 will open switch 52, 52a, but relay 20 is now held energized through switch 153, 153a as previously described. Relay 50 closes switch 53, 53a energizing counter relay 70. Relay 50 is then de-energized by action of counter relay 70 and the opening of switch 4, 4A. De-ener-

gizing relay 50 will then de-energize counter relay 70.

Relay 30 will remain energized due to shorted condition of switch 3, 3A, relay 20 will remain energized due to closed switches 3, 3A; 34, 34a; 153, 153a and 24, 24a, and relay 10 will remain energized due to closed switches 25, 25a and 15, 15a. Relay 150 also remains energized due to closed switches 155, 155a and 37, 37a. Counter relay 70 will then be energized each time the wheels of a vehicle roll over treadle 9 in either direction and close the switch 4, 4A.

It will be noted that the shorting of switches 2, 2A or 3, 3A of the treadle 9 will, after the first set of wheels of a vehicle roll over the treadle, hold the relays 10, 20 and 30, or the relays 40, 30 and 20, energized, dependent upon the direction taken. By holding the aforementioned relays energized, the circuits set up thereby are the same as though switches 3, 3A; 2, 2A and then switch 1, 1A were shorted, or switches 2, 2A; 3, 3A and then switch 4, 4A. The operation for the above combination of switches is the same as described, counter F being actuated at all times for the first combination of switches while counter R will be actuated for the second combination of switches.

If switch 2, 2A is first shorted and then switch 1, 1A, the wheels of a vehicle will actuate the counter F. After the actuation of the counter F, relay 30 will be held energized as hereinbefore described. The counter F, under this shorting condition, will be actuated regardless of the direction the first vehicle passes over the treadle after the shorting condition described. In like manner, counter R will be actuated when switch 3, 3A and then switch 4, 4A are shorted. Relay 20 will remain energized after the first actuation of counter R.

Similarly, if switch 3, 3A is shorted and then switch 1, 1A, counter F will be actuated, and relay 20 will remain energized after the first axle count. If switch 2, 2A is first shorted and then switch 4, 4A, counter R will be actuated and relay 30 will remain energized after the first axle count. In the two switch combinations last mentioned, the respective counters will be actuated regardless of the direction in which the first axle passes over the treadle 9 after the shorting condition.

Shorting switches 2, 2A and 3, 3A will bring about operating conditions similar to that when either one of the said switches were shorted alone. The first axle passing over the treadle 9, after the shorting condition occurs, will determine the directional counter to be actuated for all axles passing over the treadle.

If switches 1, 1A and 4, 4A are shorted, the device will still register the axle count on the proper directional counter. Shorting the switches 1, 1A and 4, 4A will energize relays 10 and 40, respectively. The wheels of a vehicle will then close either switch 2, 2A or switch 3, 3A first depending on the direction of travel. If switch 2, 2A is first closed, relay 20 is energized, opening switch 23, 23a. Relay 40 is then de-energized and remains de-energized until the counting operation is completed by counter F. If switch 3, 3A is closed first, relay 30 is energized, opening switch 33, 33a. Relay 10 is then deenergized until the counting operation is completed by counter R.

If one of the outside treadle switches is first shorted and one or both of the middle treadle switches are thereafter shorted, the system will be inoperative to count on either counter.

Thus assuming that treadle switch 1, 1A is first shorted and then the treadle switch 2, 2A, shorting switch 1, 1A will energize relay 10, opening switch 17, 17a; shorting switch 2, 2A will energize relay 20 opening switch 26, 26a. Switch 17, 17a being open, the shorting of treadle switch 2, 2A will not energize relay 150 as previously described. Relay 20, in holding switch 26, 26a open, will prevent the actuation of the counter relay 70 will remain open. The other circuit for energizing counter relay 70 is through the switch 154, 154a controlled by relay 150. Relay 150 not being energized, will allow switch 154, 154a to remain open, again preventing counter relay 70 from functioning. A count therefore cannot be made.

If switch 1, 1A is first shorted and then switch 3, 3A, counter relay 70 will again be prevented from functioning. The action of switch 1, 1A will again energize relay 10, opening switch 17, 17a. Shorting switch 3, 3A will energize relay 30, opening switch 36, 36a. Relay 150 will not be energized due to open switch 17, 17a and counter relay 70 will not be energized due to the open switches 36, 36a and 154, 154a. Relay 30, held energized by shorting of switch 3, 3A will hold relay 20 in an energized condition even after switch 2, 2A is allowed to open. Holding relay 20 energized would be analogous to shorting of switch 2, 2A. Shorting switch 1, 1A first, and then switches 2, 2A and 3, 3A, will also prevent counter relay 70 from functioning.

In like manner counter relay 60 will not function when switch 4, 4A is first shorted and then either or both of the switches 3, 3A or 2, 2A of treadle 9 are shorted.

Means is provided, however, to produce a signal, such as a light, when one or the other of the outside treadle switches is first closed, and one or both of the middle switches are then shorted for more than a predetermined period, whereby to give notice that the system is not operative to count passage of axles of vehicles over the treadle, said signal means being so arranged as to stop operation when the closed middle treadle switch or switches, or the closed outside switch, is again opened so that the warning signal stops operating so that the system is again in condition to count vehicle axles. Means is also provided to make a printed record of the time when the middle switch or switches have been closed for longer than a predetermined period after shorting one of the outside switches, and thus rendering the system inoperative to record passage of axles of vehicles over the treadle, and to make a second printed record of the time when the closed middle switch or switches, or the closed outside switch opens to render the system again operative to count axles of vehicles passing over the treadle.

To this end, there is provided a pair of relays 175 and 170. Relay 175 has a coil 176 connected at one end to a plus power supply. Relay 170 is provided with a coil 171 connected at one end to a plus power supply. Associated with the relay 175 is a normally open switch arm 177 adapted to be moved into engagement with a fixed contact 177a when relay 175 is energized. Associated with the relay 170 are switch arms 173, 174 and 172. Switch arms 173 and 174 are normally open but are adapted to be moved into engagement with fixed contacts 173a, 174a, respectively, when relay 170 is energized. Switch arm 172 is normally in engagement with a fixed contact 172a and is adapted to be moved by the relay 170 out

of engagement with said fixed contact and into engagement with a fixed contact 172b.

There is further provided a time delay relay 60 having a coil 61 connected at one end to a minus power supply. Said time delay relay controls switch arms 161 and 162. Switch arm 161 is normally open but is adapted to be moved into engagement with a fixed contact 161a when the time delay relay 60 is energized. Switch arm 162 is normally in engagement with a fixed contact 162b and is adapted to be moved out of engagement with respect thereto, and into engagement with a fixed contact 162a. The switch arm 161 is connected by wire 163 with signal lights or other signals 164, connected to the minus power supply. The relay 150 has furthermore associated therewith, a switch arm 156 normally in engagement with a fixed contact 156a and adapted to be opened when said relay is energized.

There is further provided a time stamp P having a printing solenoid 180 provided with a coil 181 connected at one end to a plus power supply. The solenoid 180 controls a printing platen 179 connected to a switch arm 182. When the printing plate is in normal position, the switch arm 182 contacts the fixed contact 182b. When the platen 179 is moved to a printing position, the switch arm 182 moves out of engagement with the fixed contact 182b and into engagement with a fixed contact 182a.

Switch arm 156 is connected by wire 113 to wire 28 and hence to the switch arms 18 and 48. Fixed contact 156a is connected by wire 134 to the coil 61 of the relay 60. Fixed contact 161a is connected to a plus power supply. Fixed contact 162a is connected by wire 166 to fixed contact 172a and by wire 165 to switch arm 173, and by wire 169 to switch arm 182. Switch arm 182 is connected to minus power supply. Fixed contact 162b is connected by wire 160 to fixed contact 172b. Switch arm 172 is connected by wire 163 to coil 176 of relay 175. Fixed contact 173a is connected by wire 184 to the coil 171 and by wire 167 to fixed contact 182a. Fixed contact 174a is connected to minus power supply. Switch arm 174 is connected by wire 168 to the fixed contact 182b. Switch arm 177 is connected by wire 178 to coil 181. Fixed contact 177a is connected to minus power supply.

The platen 179 is adapted to push paper and printing ribbon against date and time wheels 183, as in the usual time stamp.

The operation of the signal and printing means, when an outside treadle switch is first shorted and one or both of the middle treadle switches are then shorted, will now be described.

Under ordinary operating conditions, delayed time relay 60 will not be energized long enough to operate, nor will the delayed time relay 60 be energized if either or both switches 2, 2A and 3, 3A are first shorted. Shorting either of these two switches will energize relay 150, thereby opening switch 156, 156a.

When switch 1, 1A and then switch 2, 2A are shorted, relay 60 will be energized by the circuit through coil 61, wire 134, switch 156, 156a, wires 113 and 28, switch 18, 18a, wires 8, 29 and 124, switch 21, 21a, and wire 38. Should the delayed time relay 60 be energized for a longer period than the predetermined time set, switches 161, 161a and 162, 162a will be closed, and switch 162, 162b allowed to open.

In closing switch 161, 161a the signal 164 is actuated, the circuit being through the wire 163 and signal 164. Switch 162, 162a in closing will actu-

ate the printing solenoid 180 causing a record to be made of the time of such shorted condition. Relay 175 is energized by the circuit through the coil 176, wire 183, switch 172, 172a, wire 166 and switch 162, 162a. Relay 175 will close switch 177, 177a energizing the printing solenoid 180, the circuit being through wire 178 and coil 181. The platen 179 will then be raised and contact the time and date wheels 183, paper and a printing ribbon being interposed, recording the time of such operation.

Platen 179 in its printing position will close switch 182, 182a and open switch 182, 182b. Relay 170 will then be energized by the circuit through coil 171, wires 184 and 167, switch 182, 182a, wires 163, 165 and 166, and switch 162, 162a. Energized relay 170 will close switch 173, 173a, closing another circuit through coil 171 to hold relay 170 energized when switch 182, 182a opens, and before switch 182, 182b closes. The completed circuit is through the coil 171, wire 184, switch 173, 173a, wires 165 and 166, and switch 162, 162a.

Energizing relay 170 will open switch 172, 172a and close switches 172, 172b and 174, 174a. Opening switch 172, 172a will open the circuit energizing relay 175. Relay 175 de-energized, switch 177, 177a opens de-energizing the printing solenoid 180. Platen 179 will then return to its initial position opening switch 182, 182a and closing switch 182, 182b. Switch 182, 182b completes a circuit for holding relay 170 energized, the circuit being through the coil 171, wire 184, switch 173, 173a, wire 169, switch 182, 182b, wire 168 and switch 174, 174a.

Relay 170 will then remain energized until delayed time relay 60 is de-energized. Visual signal 164 will also remain operated until the said relay is deenergized.

The operation of the printer to record the time when the shorting clears will now be described.

Assume that the shorted condition of switch 2, 2A is cleared, relay 20 is then de-energized opening switch 27, 27a. Delayed time relay 60 is then de-energized. By opening switch 2, 2A, the circuit will again be operative as hereinbefore described.

De-energized relay 60 will then allow switches 161, 161a and 162, 162a to open, and switch 162, 162b to close. Opening switch 161, 161a will open the circuit of signal 164 and make the same inoperative. By closing switch 162, 162b the printing solenoid will again be energized.

Relay 175 will be energized by the circuit through coil 176, wire 183, switch 172, 172b, wire 160 and switch 162, 162b. Switch 177, 177a closes, energizing printing solenoid 180. Platen 179, in moving upward, opens switch 182, 182b, thereby de-energizing relay 170. Relay 170, being de-energized, will allow switch 172, 172b to open, thereby de-energizing relay 175. Switch 177, 177a opens de-energizing the printing solenoid 180, allowing platen 179 to return to its initial position.

If switches 4, 4A and 3, 3A are shorted for any length of time beyond the time set on delayed time relay 60, the said relay will be energized by the circuit through coil 61, wire 134, switch 156, 156a, wires 113 and 28, switch 48, 48a, wires 8, 29 and 124, and switch 37, 37a.

If switches 1, 1A and then switch 3, 3A are shorted, the delayed time relay 60 will again be energized. The circuit then would be through wire 134, switch 156, 156a, wires 113 and 28, switch 18, 18a, wires 8, 29 and 124 and switch 37, 37a. 75

Similarly, should switch 4, 4A and then switch 2, 2A be shorted, delayed time relay 60 will be energized through switch 48, 48a, as aforesaid, wires 8, 29 and 124, and then through switch 27, 27a. Opening switch 3, 3A or switch 2, 2A will de-energize the delayed time relay 60.

Should switch 1, 1A be shorted, and then switches 2, 2A and 3, 3A; or switch 4, 4A and then switches 2, 2A and 3, 3A, delayed time relay 60 will again be energized. The said relay will be released when both switches 2, 2A and 3, 3A are opened.

Throughout the specification and claims, the word "bridged" is used to mean "shorted" and/or "closed." Thus a "bridged switch" is one capable of influencing the operation of the disclosed circuit.

Throughout the specification the term "outer" or "outside" switches refers to switches 1, 1A and 4, 4A, and the terms "inner" and "inside" switches, refer to the switches 2, 2A and 3, 3A.

It will thus be seen that there is provided a system in which the several objects of this invention are achieved and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention and as various changes might be made in the embodiment set forth, it is to be understood that all matters herein set forth or shown in the accompanying drawing are to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. In combination with a multi-switch treadle, comprising a set of more than two switches adapted to be closed in sequential order by the wheels of a vehicle rolling thereover, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when said switches are closed sequentially in one direction and adjacent switches are closed concurrently, and to actuate the backward counter when said switches are sequentially closed in an opposite direction and adjacent switches are closed concurrently, said circuit including means to make a directional count on the forward counter upon sequentially actuating all the switches in the first direction and adjacent switches concurrently, while the first switch is bridged, and also means to make a directional count on the backward counter upon sequentially actuating all switches in an opposite direction, and adjacent switches concurrently, while the last switch is bridged.

2. In combination with a multi-switch treadle, comprising a set of more than two switches adapted to be closed in sequential order by the wheels of a vehicle rolling thereover, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when said switches are closed sequentially in one direction and adjacent switches are closed concurrently, and to actuate the backward counter when said switches are sequentially closed in an opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch of said set is bridged, and also if the last switch of said set is bridged, before and held bridged during the sequential operation of the remaining switches of said set, and also if both the first and the last switches of said set are bridged be-

fore, and held bridged, during the sequential operation of all the switches of said set.

3. In combination with a multi-switch treadle, comprising a set of more than two switches adapted to be closed in sequential order by the wheels of a vehicle rolling thereover, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when said switches are closed sequentially in one direction and adjacent switches are closed concurrently, and to actuate the backward counter when said switches are sequentially closed in an opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch of said set is bridged, and also if the last switch of said set is bridged, before and held bridged during, the sequential operation of the remaining switches of said set, and also if both the first and the last switches of said set are bridged before, and held bridged during, the sequential operation of all the switches of said set, and means to actuate one of said counters even if any of the switches of said set, other than the first or last switches of said set, is bridged before, and held bridged during, the sequential actuation of all the switches of said set.

4. In combination with a multi-switch treadle, comprising a set of more than two switches adapted to be closed in sequential order by the wheels of a vehicle rolling thereover, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when said switches are closed sequentially in one direction and adjacent switches are closed concurrently, and to actuate the backward counter when said switches are sequentially closed in an opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch of said set is bridged, and also if the last switch of said set is bridged, before and held bridged during, the sequential operation of the remaining switches of said set, and also if both the first and last switches of said set are bridged before, and held bridged during, the sequential operation of all the switches of said set, means to actuate one of said counters even if any of the switches of said set, other than the first or last switches of said set, is bridged before, and held bridged during, the sequential actuation of all the switches of said set, and means to actuate one of said counters upon passage of the wheels over the treadle in either direction even if any of the switches of said set other than the outside switches is first bridged and held bridged, and thereafter one of the outside switches is bridged and held bridged, before and during the sequential operation of all the switches of said set.

5. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means for actuating one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and for actuating the other of said devices by the sequential operation of all of said switches and the concurrent operation of adjacent switches in the reverse direction, said circuit having means for actuating said devices responsive to the direction of sequential operation of said switches even if one

of the outside switches of said set is bridged before, and held bridged during, the sequential operation of all the switches of said set.

6. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means for actuating one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and for actuating the other of said devices by the sequential operation of all of said switches and the concurrent operation of adjacent switches in the reverse direction, said circuit having means for actuating said devices responsive to the direction of sequential operation of said switches even if one of the outside switches of said set is bridged before, and held bridged during, the sequential operation of all the switches of said set, and also if both the outside switches of said set are bridged before, and held bridged during, the sequential operation of all the switches of said set.

7. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means for actuating one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and for actuating the other of said devices by the sequential operation of all of said switches and the concurrent operation of adjacent switches in the reverse direction, said circuit including means to prevent actuation of said devices when one of the outside switches of said set is first bridged and maintained bridged, and then any of the switches other than the outside switches is thereafter bridged and maintained bridged, before and during the sequential actuation of all the switches of said set.

8. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means for actuating one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and for actuating the other of said devices by the sequential operation of all of said switches and the concurrent operation of adjacent switches in the reverse direction, said circuit including means to prevent actuation of said devices when one of the outside switches of said set is first bridged and maintained bridged, and then any of the switches other than the outside switches is thereafter bridged and maintained bridged, before and during the sequential actuation of all the switches of said set, and signal means to indicate when any of the switches other than the outside switches are bridged and held bridged after an outside switch has been bridged and held bridged.

9. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means for actuating one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and for actuating the other of said devices by the sequential operation of all of said switches and the concurrent operation of adjacent switches in the re-

verse direction, said circuit including means to prevent actuating of said devices when one of the outside switches of said set is first bridged and maintained bridged, and then any of the switches other than the outside switches is thereafter bridged and maintained bridged, before and during the sequential actuation of all the switches of said set, signal means to indicate when any of the switches other than the outside switches are bridged and held bridged after an outside switch has been bridged and held bridged, means to record the time when said signal means has begun operating, and means to render the signal means inoperative when the switches other than the outside switches of said set which have been bridged and held bridged, are restored to initial condition.

10. In combination with a multi-switch treadle, comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch, and also if the fourth switch of said treadle is bridged and held bridged before and during the sequential operation of all the switches of said treadle.

11. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit interconnecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch, and also if the fourth switch of said treadle is bridged and held bridged before and during the sequential operation of all the switches of said treadle, and also if both the first and the fourth switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle.

12. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch, and also if the fourth switch of said treadle is bridged and held bridged before and during the sequential operation of all the switches of said treadle, and also if both the first and the fourth switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle, and means to actuate one of said counters upon bridging and holding bridged the second switch, and also upon bridging and holding bridged the

third switch, and also if both the second and third switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle.

13. In combination with a multi-switch treadle comprising four switches a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch, and also if the fourth switch of said treadle is bridged and held bridged before and during the sequential operation of all the switches of said treadle, and also if both the first and the fourth switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle, means to actuate one of said counters upon bridging and holding bridged the second switch, and also upon bridging and holding bridged the third switch, and also if both the second and third switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle, and means to actuate one of said counters upon passage of wheels over the treadle in either direction even if the second switch of said treadle is first bridged and held bridged, and thereafter the first switch is bridged and held bridged before and during the sequential operation of all the switches of said treadle.

14. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to prevent actuation of said counters if one of the outside switches of said treadle is first bridged and held bridged and then one of the inside switches of said treadle is bridged and maintained bridged.

15. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to prevent actuation of said counters if one of the outside switches of said treadle is first bridged and held bridged and then one of the inside switches of said treadle is bridged and maintained bridged, and signal means to indicate when an inside switch is bridged and held bridged after an outside switch has been bridged and maintained bridged.

16. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said

switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to prevent actuation of said counters if one of the outside switches of said treadle is first bridged and held bridged and then one of the inside switches of said treadle is bridged and maintained bridged, signal means to indicate when an inside switch is bridged and held bridged after an outside switch has been bridged and maintained bridged, and means to render the signal inoperative when said circuit again actuates said counters.

17. In combination with a multi-switch treadle comprising four switches, a forward counter and a backward counter, a circuit connecting both counters with said switches, including means to actuate the forward counter when all of said switches are closed sequentially in one direction, and adjacent switches are closed concurrently, and to actuate the backward counter when all of said switches are actuated sequentially in the opposite direction and adjacent switches are closed concurrently, said circuit including means to actuate the proper directional counter even if the first switch, and also if the fourth switch of said treadle is bridged and held bridged before and during the sequential operation of all the switches of said treadle, and also if both the first and the fourth switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle, and means to actuate one of said counters upon bridging and holding bridged the second switch, and also upon bridging and holding bridged the third switch, and also if both the second and third switches are bridged and held bridged before and during the sequential actuation of all the switches of said treadle, said circuit including means to prevent double actuation of said counters when the second switch, and also if the third switch is bridged and held bridged before and during the sequential operation of all the switches of said treadle.

18. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means to actuate one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and actu-

ating the other of said devices by the sequential operation of all of said switches and concurrent actuation of adjacent switches in a reverse direction, said circuit including means to actuate one of said devices when some of said switches are bridged before, and held bridged during the sequential actuation of all the switches of said set.

19. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means to actuate one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and actuating the other of said devices by the sequential operation of all of said switches and concurrent actuation of adjacent switches in a reverse direction, said circuit including means to actuate one of said devices when some of said switches are bridged before, and held bridged during the sequential actuation of all the switches of said set, means included in said circuit to prevent actuation of said devices when other switches of said set are bridged and held bridged, signal means, and means to operate said signal means when said circuit becomes inoperative to actuate said devices.

20. In combination with a set of more than two switches adapted to be actuated in sequential order, a pair of impulse registering devices, a circuit interconnecting said switches with said registering devices, including means to actuate one of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in one direction, and actuating the other of said devices by the sequential operation of all of said switches and concurrent operation of adjacent switches in a reverse direction, said circuit including means to actuate one of said devices when some of said switches are bridged before, and held bridged during the sequential actuation of all the switches of said set, means included in said circuit to prevent actuation of said devices when other switches of said set are bridged and held bridged, signal means, means to operate said signal means when said circuit becomes inoperative to actuate said devices, and means controlled by said circuit to record the time when said signal means becomes operative and again when said signal means becomes inoperative.

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