Jan. 6, 1942. B. COOPER 2,268,925

TRAFFIC COUNTING CIRCUITS

Filed Sept. 4, 1940 3 Sheets-Sheet 1

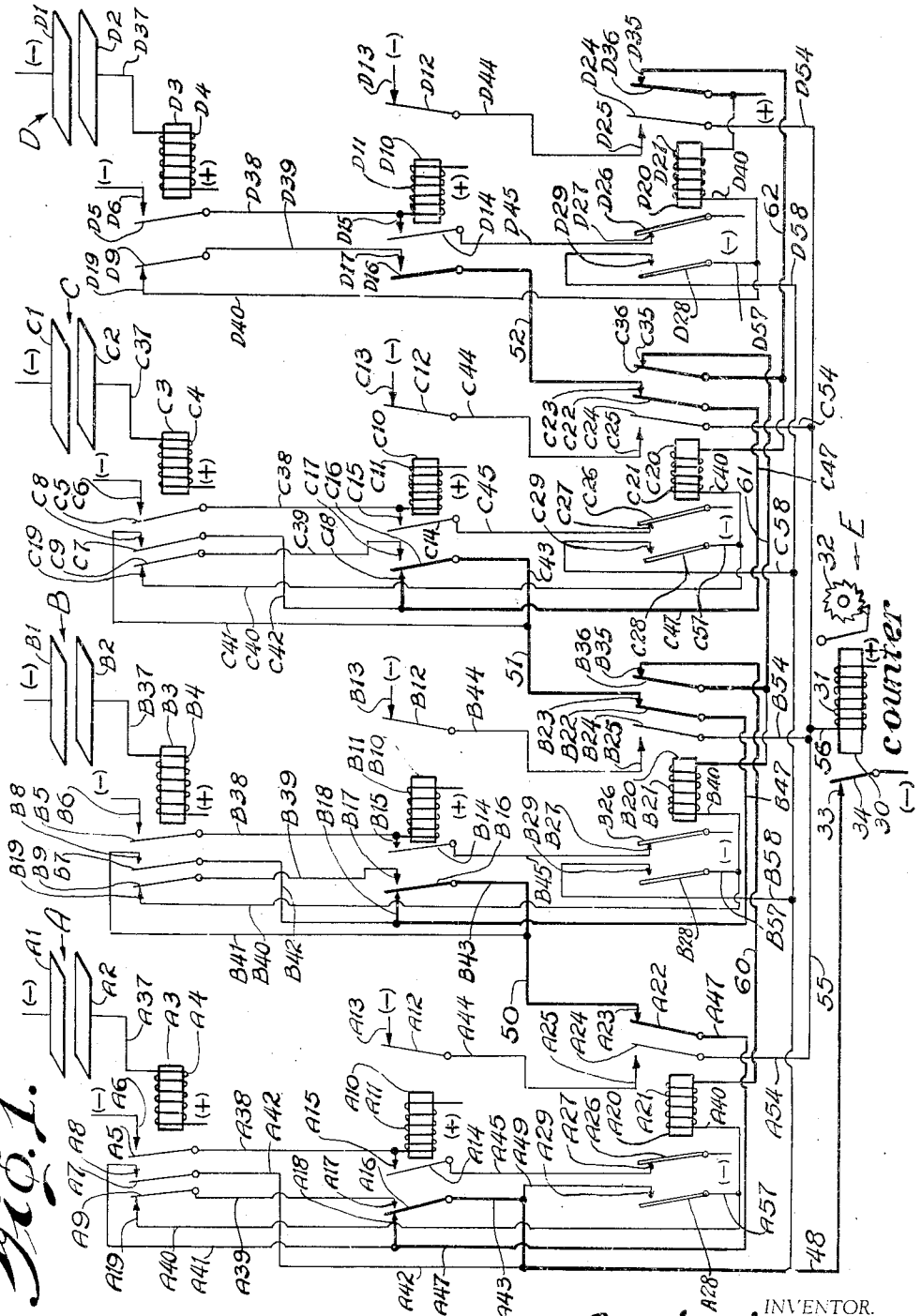


Fig. 1.

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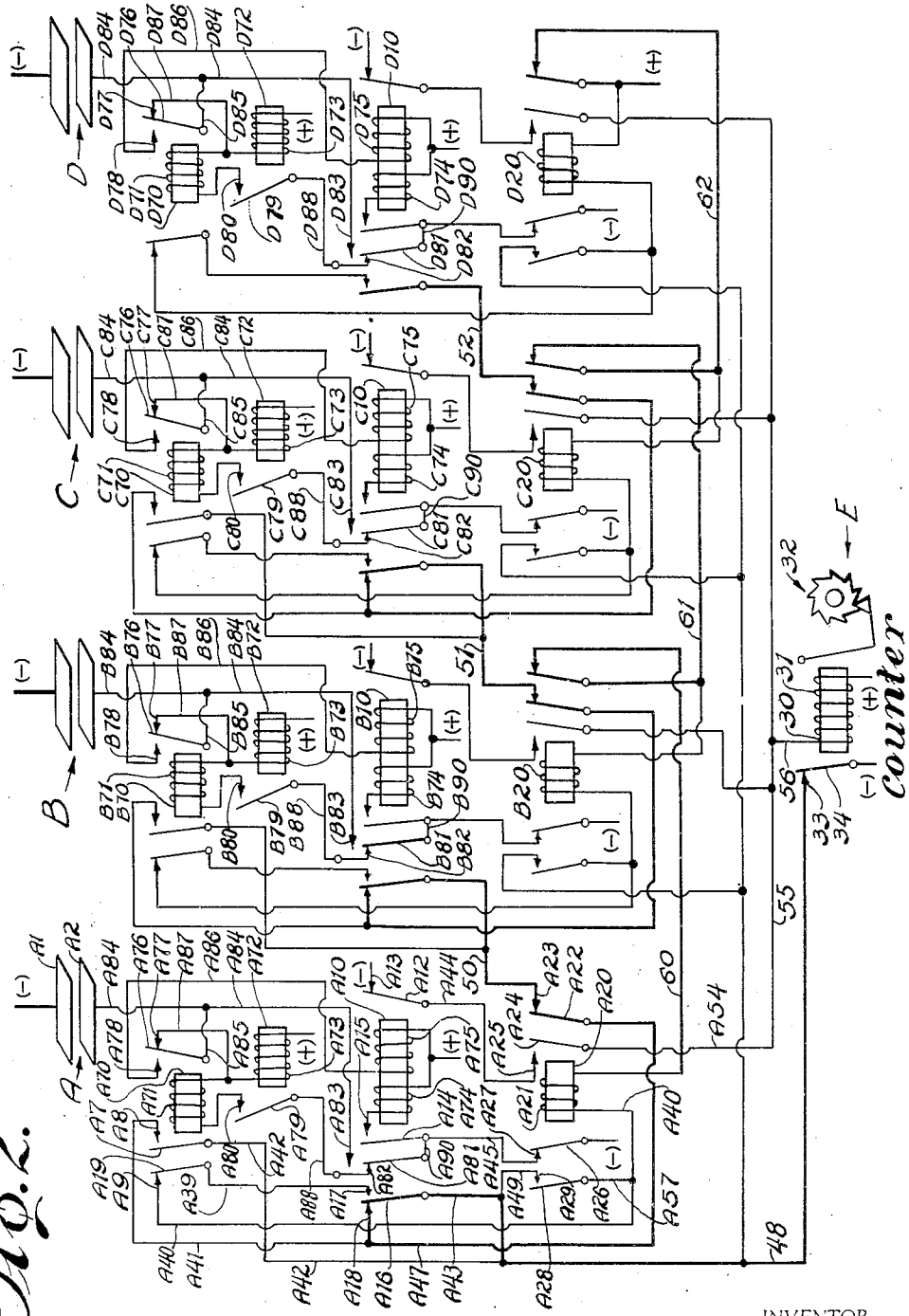


Fig. 2.

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Filed Sept. 4, 1940 3 Sheets-Sheet 3

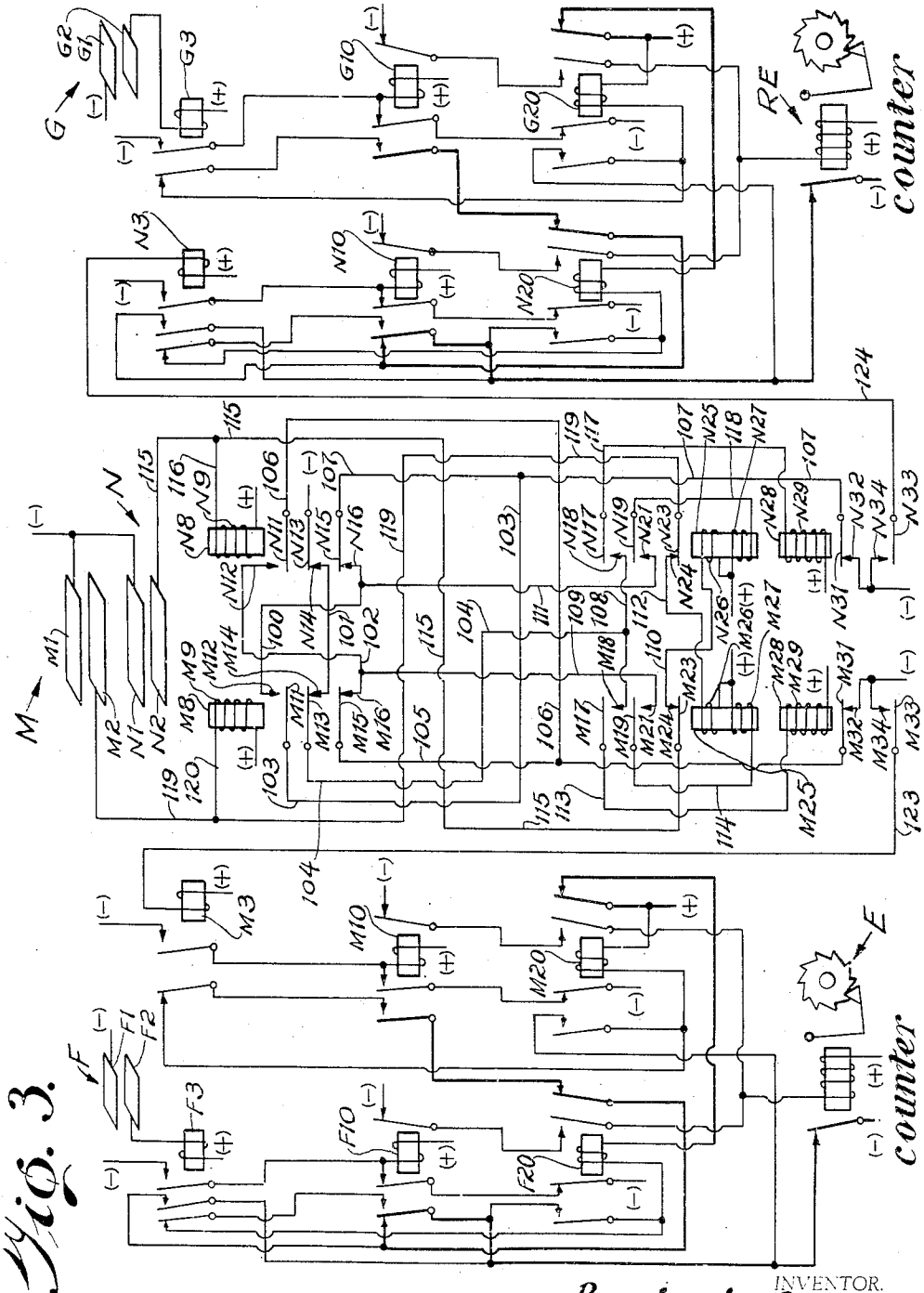


Fig. 3.

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2,268,925

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TRAFFIC COUNTING CIRCUITS

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Application September 4, 1940, Serial No. 355,330

30 Claims. (Cl. 235—92)

This invention relates to traffic counting circuits. It is particularly directed to improved means for counting and totalizing, on a single counter, the vehicular traffic on a multi-lane highway.

This application is a continuation in part of applicant's co-pending application, Serial No. 265,290, filed on March 31, 1939 for Traffic counting circuits.

Heretofore, in traffic counting installations on a multi-lane highway, a treadle switch was embedded in each lane of the highway for actuation by the wheels of a vehicle, and each treadle controlled a circuit operating a counter to count the vehicle axles passing over the said lane. In such installations it was necessary to add the counts of each counter in order to obtain the total count in all lanes. Furthermore, the initial cost of such installations proved expensive, and the operating expenses attached thereto also proved to be slightly higher than most road authorities had anticipated.

In the installation of traffic counting systems it has been found that vehicles will often come to a standstill with either the front or rear wheels resting on the treadle, thereby holding the treadle switch closed, sometimes for long periods, impressing a continuous impulse on the counting circuit, instead of a momentary impulse as when the wheels of a vehicle roll over the treadle. Furthermore, vehicles usually cross the treadles in the different lanes, simultaneously or substantially so, so that the time between actuation of treadles is less than it takes to operate a counter.

It is, therefore, an object of this invention to provide for a multi-lane highway, having a treadle switch embedded in each lane, a traffic counting circuit for registering on a counter controlled by a single electro-magnet, the total count of all vehicle axles which pass over the treadle switches in the lanes, irrespective of the duration of the actuation of the treadle switches, said circuit including means for registering on the counter the simultaneous actuations of two or more treadle switches in the various lanes, or any actuations of switches separated by a period less than is required to operate the counter.

Another object of this invention is to provide in a counting circuit of the character described, means to prevent the registration of the actuation of a treadle switch unless said treadle switch is restored to its initial condition.

It is very often desirable to count vehicles rather than vehicle axles. As the number of three-axled vehicles are negligible when compared to the number of two-axled vehicles, a counting circuit which will allow the registration of one count on the counter for each two actuations of a treadle switch will give an accurate vehicle count, especially on our motor parkways, toll bridges and tunnels, and in our national and state parks where two-axled vehicles predominate.

It is, therefore, still a further object of this invention to provide in a counting circuit of the character described, means to actuate the totalizing counter only once for the passage of two vehicle axles over the treadles in the lanes, said circuit including further means to prevent the registration of false counts on said counter irrespective of the duration of closures of the treadle switches.

On some highways there are lanes for traffic in one direction only, and common lanes for two-way traffic. Thus, in a three-lane highway, one outside lane is used for traffic in one direction, and the other outside lane is used for traffic in the opposite direction, while the center lane may be used for traffic moving in either direction.

It is, therefore, still another object of this invention to provide a traffic counting circuit of the character described, to count the vehicle traffic moving in one direction on one counter, and to count the vehicle traffic moving in the opposite direction on another counter, said circuit including means to register on the proper directional counter the traffic moving in either direction in lanes used in common on which traffic may move in either direction.

Another object of this invention is to provide a counting circuit of the character described which may be readily expanded to use any desired number of switches, and which may be readily reduced to as few switches as desired.

Another object of this invention is to produce a highly improved circuit 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, become obvious and, in part, be hereinafter pointed out.

This invention accordingly consists in features of construction, combination of elements, and arrangement of parts which are exemplified in construction hereinafter described, and of which the scope of this application will be indicated in the following claims.

In the accompanying drawings,

Fig. 1 is a wiring diagram of a counting circuit embodying the invention for totalizing traffic in a plurality of lanes;

Fig. 2 is a wiring diagram of a counting circuit embodying the invention for totalizing traffic in a plurality of lanes, and adapted to count every other vehicle axle; and

Fig. 3 is a wiring diagram of a counting circuit embodying the invention for totalizing traffic on a three-lane highway wherein the center lane may be used by vehicles passing in either direction.

Referring now in detail to Fig. 1 of the drawings, there is illustrated a circuit embodying the invention comprising single switch treadles, A, B, C, and D, of any suitable construction embedded, one in each of the lanes of a highway, traversely of the lane. Each treadle switch comprises two contacts A1—A2, B1—B2, C1—C2, and D1—D2, respectively. Each switch may comprise a pair of long metallic top and bottom strips normally out of contact and positioned perpendicularly to the normal direction of vehicular traffic, so that a wheel passing over one of the treadle switches will press the two contacts thereof together and close the switch, the switch opening when the wheel rolls off the treadle.

Associated with each treadle A, B, C, and D are three relays numbered A3, A10 and A20; B3, B10 and B20; C3, C10 and C20; and D3, D10 and D20, respectively. For purposes hereinafter appearing, the relays A3, B3, C3 and D3 will be referred to as operating relays, relays A10, B10, C10 and D10 will be referred to as primary relays, and relays A20, B20, C20 and D20 will be referred to as secondary relays.

Operating relays A3, B3, C3 and D3 have actuating coils A4, B4, C4 and D4, respectively. Primary relays A10, B10, C10 and D10 have actuating coils A11, B11, C11, and D11, respectively; and the secondary relays A20, B20, C20, and D20 have actuating coils A21, B21, C21 and D21, respectively.

Associated with each of the operating relays A3, B3, and C3 are three switch arms adapted to be actuated by their respective relays. The following description is limited to the purposes and operation of but two switches; the purpose and operation of the third switch arm will be hereinafter disclosed.

Associated with operating relay A3 are two switch arms A5 and A9. Switch arm A5 is normally open and is adapted to engage fixed contact A6 when the relay A3 is energized. Switch arm A9 is normally in engagement with fixed contact A19 but is adapted to be moved into open position when said relay is energized.

Associated with the operating relay B3 are two switch arms B5 and B9. Switch arm B5 is normally open and is adapted to engage the fixed contact B6 upon energization of relay B3. Switch arm B9 is normally in engagement with fixed contact B19 and is adapted to be moved into open position when said relay is energized.

Associated with relay C3 are two switch arms C5 and C9. Switch arm C5 is normally open and is adapted to engage fixed contact C6 upon energizing said relay. Switch arm C9 normally engages fixed contact C19 and is adapted to be moved into open position upon energizing said relay.

Associated with the operating relay D3 are two switch arms D5 and D9. Switch arm D5 is normally open and adapted to engage fixed contact D6 upon energizing the relay and switch arm D9 is normally in engagement with fixed contact D19 and adapted to be moved into open position upon energizing said relay.

Associated with the primary relay A10 are the three switch arms A12, A14 and A16. Switch arm A12 is normally in engagement with fixed contact A13 and is adapted to be moved into open position upon energizing relay A10. Switch arm A14 is normally in open position and is adapted to engage fixed contact A15 upon energizing said relay. Switch arm A16 is normally in engagement with fixed contact A18 and is adapted to be moved into open position in respect therewith and into engagement with fixed contact A17 upon energizing said relay.

Associated with the relay B10 are three switch arms B12, B14 and B16. Switch arm B12 normally engages fixed contact B13 and is adapted to be moved into open position upon energizing relay B10. Switch arm B14 is normally in open position and adapted to engage fixed contact B15 upon energizing the relay. Switch arm B16 normally engages fixed contact B18 and is adapted to be moved out of engagement therewith and into engagement with fixed contact A17 upon energizing said relay.

Associated with the primary relay C10 are three switch arms C12, C14 and C16. Switch arm C12 normally engages fixed contact C13 and is adapted to be moved into open position upon energizing relay C10. Switch arm C14 is normally in open position and is adapted to engage fixed contact C15 upon energizing said relay. Switch arm C16 normally engages fixed contact C18 and is adapted to be moved out of engagement therewith and into engagement with fixed contact C17 upon energizing said relay.

Associated with the primary relay D10 are also three switch arms D12, D14 and D16. Switch arm D12 normally engages fixed contact D13 and is adapted to be moved into open position upon energizing relay D10. Switch arm D14 is normally in open position and is adapted to engage fixed contact D15 upon energizing said relay. Switch arm D16 is normally in open position and is adapted to engage fixed contact D17 upon energizing said relay.

Associated with the secondary relay A20 are four switch arms A22, A24, A26 and A28. Switch arms A22 and A26 normally engage fixed contacts A23 and A27, respectively, and are adapted to be moved into open position upon energization of the relay. Switch arms A24 and A28 are normally in open position and are adapted to engage fixed contacts A25 and A29 respectively upon energization of said relay.

Associated with the secondary relay B20 are five switch arms B36, B22, B24, B26 and B28. Switch arms B36, B22 and B26 normally engage fixed contacts B35, B23 and B27, respectively, and are adapted to be moved into open position upon energizing relay B20. Switch arms B24 and B28 are normally in open position and are adapted to engage fixed contacts B25 and B29, respectively, upon energizing said relay.

Associated with secondary relay C20 are also five switch arms C36, C22, C24, C26 and C28. Switch arms C36, C22 and C26 normally engage fixed contacts C35, C23, and C27, respectively, and are adapted to be moved into open position upon energizing the relay. Switch arms C24 and C28 are normally in open position and are adapted to engage fixed contacts C25 and C29, respectively, upon energizing said relay.

Associated with the secondary relay D20 are four switch arms D36, D24, D26 and D28. Switch arms D36 and D27 normally engage fixed contacts D35 and D37, respectively, and are adapted to be moved into open position upon energizing the relay. Switch arms D24 and D28 are normally open and adapted to engage fixed contacts D25 and D29, respectively, upon energizing said relay.

It will be noted that the secondary relays of the first and last treadles each control four switches, whereas the secondary relays of intermediate treadles each control five switches.

In the circuit there is provided an electromagnetic counter E of any suitable construction, having an electro-magnet 30 provided with the actuating coil 31 and controlling the counting mechanism 32. Associated with the electromagnet 30 is a switch arm 34 normally engaging fixed contact 33 and adapted to be moved into open position upon energization of said electromagnet.

The contact strips A1, B1, C1, and D1 are connected to negative power supply. The other contact strips A2, B2, C2 and D2 are connected by wires A37, B37, C37 and D37 to the coils A4, B4, C4 and D4, espectively. The other ends of coils A4, B4, C4 and D4 are connected to plus power supply.

Fixed contacts A6, B6, C6 and D6 are connected to minus power supply. Switch arms A5, B5, C5 and D5 are connected by wires A38, B38, C38 and D38 to the coils A11, B11, C11 and D11, respectively. Switch arms A9, B9, C9 and D9 are connected by wires A39, B39, C39 and D39, to the fixed contacts A17, B17, C17 and D17, respectively. Contacts A19, B19, C19 and D19 are connected by wires A40, B40, C40 and D40 to the coils A21, B21, C21 and D21, respectively.

The other end of each of coils A11, B11, C11 and D11 is connected to plus power supply. The fixed contacts A13, B13, C13 and D13 are connected to minus power supply. The switch arms A12, B12, C12 and D12 are connected by wires A44, B44, C44 and D44 to the fixed contacts A25, B25, C25 and D25, respectively. Switch arms A14, B14, C14 and D14 are connected by wires A45, B45, C45 and D45 to the fixed contacts A27, B27, C27 and D27, respectively. Fixed contacts A15, B15, C15 and D15, are connected to the coils A11, B11, C11 and D11, respectively. Fixed contacts A18, B18 and C18 are connected by wires A47, B47 and C47 to the switch arms A22, B22, and C22, respectively.

The switch arm A16 is connected by the wire A43 and wire 48 to the fixed contact 33 and by the wire A43 and wire A49 to the fixed contact A29. The switch arms B16 and C16 are connected by the wires B43 and C43 and wires 50 and 51 to the fixed contacts A23 and B22, respectively. Switch arm D16 is connected by wire 52 to a fixed contact C23.

The switch arms A24, B24, C24 and D24 are connected by wires A54, B54, C54 and D54, respectively, and by wires 55 and 56 to coil 31 of the counter E. The switch arms A26, B26, C26 and D26 are connected to minus power supply. Switch arms A28, B28, C28 and D28 are connected by wires A57, B57, C57 and D57 to the wires A40, B40, C40 and D40, respectively. The fixed contacts B29, C29 and D29 are connected by wires B58, C58 and D58 to the wire 48 which leads to the fixed contact 33.

Switch arms B36 and C36 are connected by of the electro-magnet 30 to plus power supply, wires 61 and 62 to the fixed contacts C35 and D35, respectively. Coil A21 is connected by wire 60 to the fixed contact B35; coil B21 is connected by wire 61 to the fixed contact C35; coil C21 is connected by wire 62 to the fixed contact D35 and coil D21 is connected to the switch arm D36. Switch arm D35 is connected to plus power supply.

For purposes hereinafter appearing, the two circuits appearing in heavier lines in Fig. 1, will be known as chain circuits. The circuit emanating from the negative power supply and traceable through switch 34—33, wires 48 and A43, switch A16—A18, wire A47, switch A22—A23, wires 50 and B43, switch B16—B18, wire B47, switch B22—B23, wires 51 and C43, switch C16—C18, wire C47, switch C22—C23, wire 52 to switch arm D16, will be referred to as the negative chain. The circuit emanating from the positive power supply and traceable through switch D36—D35, wire 62, switch C36—C35, wire 61, switch B36—B35, and wire 60 to one side of coil A21 will be referred to as the positive chain.

The operation of the circuit will now be described when a vehicle wheel passes over and closes any treadle switch, such as C.

When treadle circuit C is closed relay C3 becomes energized, the circuit being through wire C37 and coil C4. Switch C9—C19 opens and switch C5—C6 closes, completing a circuit from minus power supply through wire C38 and coil C11 to plus power supply energizing the primary relay C10.

Energizing the primary relay C10 will open switches C12—C13 and C16—C18 and close the switches C14—C15 and C16—C17. Closing switch C14—C15 completes a holding circuit for coil C11, the circuit being through switch C14—C15, wire C45, switch C26—C27, to minus power supply, thereby maintaining relay C10 energized after the wheels of a vehicle roll over the treadle allowing the switch C1—C2 to open.

Opening the treadle switch C will allow the operating relay C3 to become de-energized permitting switch C9—C19 to close. Closing of switch C9—C19 will energize the secondary relay C20, by connecting one end of the coil C21 of said relay to the negative chain heretofore described. The circuit connection to the negative chain of coil C21 is through the wire C40, the switch C9—C19, wire C39, switch C16—C17 and wire 51. The other end of coil C21 is connected to the wire 62 of the positive chain heretofore described.

It will be noted that to energize the secondary relay C20, treadle switch C must open to allow operating relay C3 to become de-energized thereby permitting switch C9—C19 to close, to complete the energizing circuit for the secondary relay.

Energizing the secondary relay C20 will close the switches C24—C25 and C28—C29 and open the switch C26—C27. By closing switch C28—C29 a holding circuit is completed to hold relay C20 energized when primary relay C10 becomes de-energized, the circuit being from the coil C21 of said relay, through the wires C40 and C57, switch C28—C29, wire C58 to wire 48 of the negative chain. Opening switch C26—C27 will open the holding circuit of the primary relay C10 allowing said relay to become de-energized.

By de-energizing the primary relay C10, switch C12—C13 closes completing a circuit to actuate the counter E. The completed circuit is from minus power supply, switch C12—C13, wire C44, switch C24—C25, wires C54, 55 and 56, coil 31

The electro-magnet 30 actuates the counting mechanism 32, thereby registering one count on the counter E for the passage of a wheel over the treadle C.

By energizing the electro-magnet 31, switch 34—33 opens, thereby opening the circuit of the negative chain. The secondary relay C20 becomes de-energized allowing switch C24—C25 to again open. By opening switch C24—C25, the circuit of the counter coil 31 will be opened, permitting the de-energization of the said coil. Thus, the entire counting circuit is restored to normal for reactuation by the closure of another treadle.

It will be noted that the procedure for actuating the counter comprises briefly the following: firstly, the actuation of any treadle excites the corresponding operating relay, said relay closing a circuit to energize its corresponding primary relay; secondly, the energization of the primary relay completes a holding circuit for itself through a switch arm controlled by its associated unexcited secondary relay; thirdly, the energization of the primary relay energizes its associated secondary relay, provided the positive and negative chains are in condition to permit said energization, as heretofore explained; fourthly, the energization of the secondary relay causes the de-energization of its associated primary relay, thereby completing a circuit through a counter coil and permitting registration of an axle count on the counter; and fifthly, the actuation of the counter resets the circuit for further operation by another set of vehicle wheels.

If two treadles are actuated, one as soon after the other that the counter does not complete the count of the first actuation before the second treadle is actuated, the counter will nevertheless count the actuations in sequence.

The operation of the counting circuit will now be described when a treadle is actuated so soon after actuation of another treadle that the secondary relay, associated with the other treadle, is still energized. Assuming that treadle switch B is closed while secondary relay C20 is energized, due to a prior actuation of treadle C, said closure of treadle B energizes relay B3 to energize the primary relay B10, said primary relay then being held excited through switches B14—B15 and B26—B27. However, since the positive chain has been disrupted at switch C36—C35 by the now energized relay C20, relay B20 cannot be energized and relay B10 remains energized after treadle switch C is released. However, as soon as relay C20 actuates the counter, and is released by opening of switch 34—33, the positive chain is re-established at switch C36—C35. Relay B20 is then able to become energized for releasing its primary relay B10, thereby actuating the counter to register a second count. Thereafter relay B20 is also released and the circuit returned to normal, both counts having been separately registered.

In a very similar manner, if treadle D had been closed instead of B while relay C20 is energized, the operating relay D3 would be energized, energizing the primary relay D10. However, since the negative chain is broken at switch C22—23, secondary relay D20 will not be energized until relay C20 has actuated the counter and de-energized, allowing the negative chain to be re-established as far as switch arm D16. Relay D20 will then be energized and actuate the counter E registering the second count.

Thus, when the circuit is previously inactive and two treadles are actuated close together, the secondary relays for said treadles are energized successively in the order in which the treadles are closed.

The circuit will also count simultaneous actuations of the treadles.

The operation of the circuit will now be described when several treadles, such as B, C, and D are operated simultaneously. In a manner similar to that heretofore described, the operating relays B3, C3 and D3 will be energized, energizing their respective primary relays B10, C10 and D10. Since none of the secondary relays have yet been energized, the positive chain has not been disrupted, but the negative chain is complete only to switch arm B16, thereby allowing only relay B20 to become energized. The primary relays C10 and D10 accordingly will both remain energized under the influence of their respective holding circuits, as heretofore described, after their treadle switches are released. As relay B20 energizes, it opens the negative chain at switch B22, B23, thereby preventing relay C20 from energizing until relay B20 has energized the counter and become de-energized. Relay C20 is then allowed to energize, to operate the counter while holding off the energization of relay D20 in a similar manner. Lastly, the secondary relay D20 is allowed to become energized to operate the counter, thereby completing the registration of three axle counts for the three treadles simultaneously actuated.

Thus, as several treadles are simultaneously actuated, the secondary relays associated therewith are energized in a predetermined order to operate the counting mechanism.

This invention, comprising the totalizing counting circuit as disclosed in Fig. 1, may be expanded or reduced to include any number of counting stations. To expand the circuit, it is necessary only to extend the positive and negative chains to include as many counting stations as desired. The operating relays and the primary and secondary relays of additional stations are interconnected with the counter and the treadles in a manner similar to that described and shown in the drawings, the first and last stations being similar to stations A and D, and the intermediary stations being similar to stations B and C.

It will now be noted that only one count is made on the counter for one actuation of a treadle switch irrespective of the duration of the actuation.

Should any of the treadle switches be closed, such as B, for any considerable length of time, the operating relay B3 will be energized and remain energized as long as treadle switch B is closed. The primary relay B10 becomes energized in the manner heretofore described, closing the switch B16—B17, thereby continuing the negative chain through wire B39 to switch arm B9.

One end of coil B21 is connected to wire 61 of the positive chain while the other end of said coil is connected by wire B40 to the fixed contact B19. Due to the energized condition of relay B3, switch B9—B19 is held open thereby preventing the connection of the coil B21 into the negative chain. Upon opening treadle switch B, the operating relay B3 will become de-energized thereby permitting the energization of the secondary relay B20. The circuit will then function as before, registering a single count for the one closure of the treadle switch.

Means is further provided in the circuit to permit the counting operations of the remaining treadles should one or more of the treadles be shorted in any manner for any considerable length of time, as for example, if a vehicle stops with a wheel on the treadle.

To this end, there are provided the switch arms A7, B7, C7, associated with the operating relays A3, B3 and C3. Said switch arms are normally in open position and are adapted to be moved into engagement with fixed contacts A8, B8 and C8, respectively, upon energizing the said relays. Switch arm A7 is connected by wires A42 and A43 to switch arm A16, and by wires A42 and 48 to the fixed contact 33. The fixed contact A8 is connected by wire A41 to fixed contact A18. Switch arms B7 and C7 are connected by wires B42 and C42 to the fixed contacts B18 and C18. Fixed contacts B8 and C8 are connected by wires B41 and 50; and C41 and 51 to fixed contacts A23 and B23, respectively, and by wires B41 and B43; and C41 and C43 to switch arms B16 and C16, respectively.

Should treadle D be shorted in any manner, the operation of the circuit would be the same as hereinabove described. The shorting of treadle D will energize the operating relay D3 thereby energizing the primary relay D10. The secondary relay D20 would in no way be energized as the energization of the operating relay will open switch D9—D19 thereby opening the continuation of the negative chain. As all the other secondary relays are connected into the negative chain ahead of secondary relay D20, the said relays will be energized in the manner hereinbefore described.

Should treadle B be shorted in any manner, operating relay B3 will become energized, thereby closing switches B7—B8 and B5—B6 and opening switch B9—B19. Closing switch B5—B6 will energize the primary relay B10, opening switch B16, B18. The secondary relay B20 cannot become energized until switch B9—B19 again closes, so that coil B21 of said relay may be connected into the negative chain.

If treadle C were to be actuated during the shorted condition of treadle B, the actuation of treadle C will be registered on the counter. When the primary relay C10 becomes energized, switch C16—C17 closes, and when relay C3 becomes de-energized switch C9—C19 closes, thereby connecting the coil C21 of the secondary relay C20 into the negative chain.

However, due to the shorting of treadle B, the primary relay B10 is energized and holds switch B16—B18 open thereby breaking the negative chain at that point. The negative chain instead of passing through the switch B16—B18 follows the shunt circuit around this break in the chain through wire B42, switch B7—B6, wire B41 to wire 50 of the negative chain. The secondary relay C20 may then become energized and actuate the counter E as hereinbefore described.

If treadle A were to be actuated while treadle B is shorted, the secondary relay A20 will be energized in the identical manner as heretofore described. The shorting of treadle B does not affect secondary relay A20 as it is connected into the negative chain ahead of the break in said chain at open switch B16—C18. The positive chain is not broken because secondary relay B20 remains de-energized.

By preventing the secondary relays from becoming energized until the release of the treadle switch, the positive chain is kept intact; and by the addition of the shunt circuits across the switches opened by the energization of the primary relays, the negative chain is kept intact, thus providing the means for energizing a secondary relay upon actuation of its treadle even though other treadles may be shorted in any manner and for any considerable length of time.

The circuit of Fig. 2 schematically illustrates a counting system for registering on the totalizing counter the passage of every other vehicle axle in a lane. There is provided a four station totalizing counting circuit similar to that disclosed in Fig. 1.

Associated with each treadle A, B, C, and D, are two operating relays A70, A72; B70, B72, C70, C72; and D70, D72, respectively. The operating relays A70 and A72 have actuating coils A71 and A73, respectively, connected in series; operating relays B70 and B72 have actuating coils B71 and B73, respectively, connected in series; operating relays C70 and C72 have actuating coils C71 and C73, respectively, connected in series; and operating relays D70 and D72 have actuating coils D71 and D73, respectively, connected in series. The primary relays A10, B10, C10 and D10 have two actuating coils A74, A75; B74, B75; C74, C75; and D74, D75, respectively.

Associated with the operating relays A70, B70, C70 and D70, are the switches A7—A8, A9—A19; B7—B8, B9—B19; C7—C8, C9—C19; and D9—D19, respectively, and their connections into the circuit as heretofore described. Associated with the said operating relays are the switch arms A76, B76, C76 and D76, respectively. Switch arms A76, B76, C76 and D76 are normally in engagement with fixed contacts A77, B77, C77 and D77, respectively, and are adapted to be moved out of engagement therewith and into engagement with fixed contacts A78, B78, C78 and D78, respectively, upon energizing said relays.

Associated with the operating relays A72, B72, C72 and D72, are the switch arms A79, B79, C79 and D79, respectively, said switch arms being normally in open position and adapted to be moved into engagement with fixed contacts A80, B80, C80 and D80, respectively, upon energizing their respective operating relays.

Associated with the primary relays A10, B10, C10 and D10, are the switches A12—A13, A14—A15, A16—A17, A19; B12—B13, B14—B15, B16—B17, B18; C12—C13, C14—C15, C16—17, C18; and D12—D13, D14—D15, D16—D17, D18; respectively, and their connections into the circuit, as heretofore described. Associated with the said primary relays are make-before-break switches comprising switch arms A81, B81, C81 and D81, spring contacts A82, B82, C82, and D82, and fixed contacts A83, B83, C83 and D83, respectively. Said switch arms normally engage spring contacts A82, B82, C82 and D82, respectively, and are adapted to be moved into open position upon energizing said primary relays. Fixed contacts A83, B83, C83 and D83 are adapted to be engaged by their respective spring contacts upon movement of the respective switch arms and before said switch arms break contact with their respective spring contacts.

Treadle contacts A2, B2, C2 and D2 are connected by wires A84, B84, C84 and D84 to the fixed contacts A83, B83, C83 and D83, respectively. Switch arms A76, B76, C76 and D76 are connected to the wires A84, B84, C84 and D84 by wires A85, B85, C85 and D85, respectively. The fixed contacts A78, B78, C78 and D78 are connected by wires A86, B86, C86 and D86 to

one end of the coils A75, B75, C75 and D75, respectively. The fixed contacts A77, B77, C77 and D77 are connected by wires A87, B87, C87 and D87 to the series connection of coils A71, A73; B71, B73; C71, C73 and D71, D73, respectively.

The fixed contacts A80, B80, C80 and D80 are connected to coils A71, B71, C71 and D71, respectively. The ends of coils A73, B73, C73 and D73 are connected to plus power supply. Switch arms A79, B79, C79, and D79 are connected by wires A88, B88, C88 and D88 to the spring contacts A82, B82, C82 and D82, respectively. Fixed contacts A15, B15, C15 and D15 are connected to one end of the coils A74, B74, C74 and D74, respectively, while the other ends of said coils are connected to plus power supply. The coils A75, B75, C75 and D75 are connected to plus power supply. The switch arms A81, B81, C81 and D81 are connected by wires A90, B90, C90 and D90 to the switch arms A14, B14, C14 and D14, respectively.

When a vehicle traverses a treadle, such as A, and the front wheels of the vehicle close said switch, the operating relay A72 is energized, the circuit being from minus power supply through treadle switch A, wires A84 and A85, switch A76—A77, wire A87, and coil A73 to plus power supply. Energizing relay A72 will close switch A79—A80. Coil A71 of the other operating relay is now connected into the circuit by the closure of said switch. However, operating relay A70 canot become energized as its coil is connected at one end to minus power supply through the switches A79—A80, A81—A82, wires A90 and A45 and switch A26—A27, and at its other end to the minus power supply through the treadle switch A. As the front wheels release treadle A, relay A70 thereupon becomes energized in series with relay A72, the circuit being minus power supply through switches A26—A27, A81—A82, and A79 and A80, the coils A71 and A73 to plus power supply. Energizing relay A70 will open switches A76—A77 and A9—A19 and close switches A76—A78 and A7—A8.

When the rear wheels of a vehicle pass over and close treadle A for the second time, primary relay A10 will become energized, the circuit being from minus power supply through switch A1—A2, wires A84 and A85, switch A76—A78, wire A86, coil A75 to plus power supply. Energizing the primary relay A10 will close switch A14—A15 completing a holding circuit for coil A74 through the said switch and switch A26—A27, and open switch A81—A82. In opening switch A81—A82 contact is made by the spring contact A82 and fixed contact A83, thus completing a circuit to hold the operating relays A70 and A72 energized through the treadle switch A.

Upon release of the treadle switch A, the operating relays A70 and A72 become de-energized allowing the counting circuit to operate in a manner identical to that heretofore described in connection with Fig. 1. The secondary relay A20 then becomes energized, de-energizing the primary relay A10, thereby actuating the counter E. Thus, only one count is registered for the passage of two vehicle axles over the treadle A. The counter E will be similarly operated upon every other actuation of treadles B, C, and D.

It will be noted that the circuit disclosed in Fig. 2 has the identical positive and negative chains as disclosed in Fig. 1. Switches A7—A8, B7—B8, and C7—C8, and their respective connections are also provided for the purpose of allowing the energization of the secondary relays other than the one having its respective treadle switch shorted. Similarly, the switches A9—A19, B9—B19, C9—C19 and D9—D19 are also provided in association with the operating relays A70, B70, C70 and D70, respectively, to prevent the energization of the secondary relays should their respective treadle switches be shorted.

It will be further noted that should a treadle switch, such as B, be shorted, or closed for a long period, as and for a first closure, operating relay B72 will be energized alone. Operating relay B70 or the primary relay B10 will not be affected by such a closure. It will only be upon the subsequent opening of treadle switch B that these relays will be energized as hereinbefore described.

Should the treadle switch B be shorted as and for a second closure the make-before-break switch B81—B82, B83 comes into play, providing a connection to the minus power supply through the treadle switch B and wire B84 thus holding the two operating relays A70 and A72 energized until released by opening of said treadle switch.

By retaining operating relay B3 energized, switch B9—B19 remains open thereby preventing the energization of the secondary relay B20, and switch B7—B8 is closed completing the shunt circuit around the opened negative chain to permit the energization of the secondary relays C20 and D20.

In traffic counting installations where it is necessary to independently totalize vehicles traveling in opposite directions, an alternative embodiment of this invention provides two counters, and permits the directional totalization of vehicles traveling over the highway. Fig. 3 represents a totalizing counting circuit adapted for use on a three-lane highway in which one outside lane has traffic moving in one direction, the other outside lane has traffic moving in the opposite direction, while the center lane may have traffic moving in either direction.

Accordingly a treadle F is embedded in an outside lane to be actuated by vehicles passing in that lane in one direction, and a treadle G embedded in the other outside lane to be actuated by vehicles passing in that lane in the opposite direction. In the center lane, two treadles are embedded, M and N, and so disposed in said lane that the wheels of an axle moving in that lane will first close one and then the other, meanwhile holding the first treadle closed, and then release the first closed treadle switch and then the second.

Associated with treadle switch F are the operating relay F3, the primary relay F10 and the secondary relay F20. Associated with treadle switch M are the operating relay M3, primary relay M10 and secondary relay M20. The counting circuit for the treadles F and M includes counter E for totalizing the count in one direction.

Associated with treadle G are the operating relay G3, the primary relay G10 and the secondary relay G20, while treadle N has associated therewith the operating relay N3, the primary relay N10 and the secondary relay N20. The counting circuit for G and N includes counter RE for totalizing the count in the opposite direction. The two totalizing circuits are similar in construction and identical in function and mode of operation to the four station totalizing circuit disclosed in Fig. 1.

Associated with treadle switch M are three relays M8, M25 and M28 having actuating coils M9, M26—M27, and M29, respectively. Treadle

switch N has associated therewith three similar relays N8, N25, and N28, having actuating coils N9, N26—N27, and N29, respectively.

Associated with relay M8 is switch arm M11, normally held open, and adapted to engage fixed contact M12 upon energization of said relay. Switch arms M13 and M15 are also associated with said relay and normally in engagement with fixed contacts M14 and M16, respectively, and adapted to be moved out of engagement therewith upon energization of said relay.

Associated with the relay N8 are three switch arms N11, N13 and N15. Switch arm N11 is normally held open but upon energization of said relay will engage fixed contact N12. Switch arms N13 and N15 are normally in engagement with fixed contacts N14 and N16, respectively, and are adapted to be moved into open position upon energization of said relay.

Associated with the relay M25 are three switch arms M17, M19, and M23. Switch arms M17 and M19 are normally open and are adapted to engage fixed contacts M18 and M21, respectively, upon energization of said relay. Switch arm M23 normally engages fixed contact M24 and is adapted to be moved into open position upon energization of said relay.

Associated with the relay M25 are three switch arms N17, N19 and N23. Switch arms N17 and N19 are normally open, and are adapted to engage fixed contacts N18 and N21, respectively, upon energization of said relay. Switch arm N23 normally engages fixed contact N24 and is adapted to be moved into open position upon energization of said relay.

Associated with the relay M28 are two switch arms M31 and M33. Switch arm M31 normally engages fixed contact M32 and is adapted to be moved into open position upon energization of said relay. Switch arm M33 is normally open and is adapted to engage fixed contact M34 upon energization of said relay.

Associated with the relay N28 are two switch arms N31 and N33. Switch arm N31 normally engages fixed contact N32 and is adapted to be moved into open position upon energization of said relay. Switch arm N33 is normally open and is adapted to engage fixed contact N34 upon energization of said relay.

Treadle contacts M1 and N1 are connected to minus power supply. Treadle contact M2 is connected by wire 119 to switch arm N23 and by wires 119 and 120 to one end of coil M9 of relay M8. The other end of coil M8 is connected to plus power supply. Treadle contact N2 is connected by wire 115 to switch arm M23 and by wires 115 and 116 to one end of coil N9 of relay N8. The other end of said coil is connected to plus power supply.

The switch arm M11 is connected by wires 103 and 107 to switch arms N15 and N31. Switch arm M13 is connected by wires 104 and 108 to the fixed contacts M18 and N18. Switch arm M15 is connected by wire 105 to switch arm M31 and by wires 105 and 106 to switch arm N11. Fixed contact M12 is connected by wire 100 to fixed contact N16 and by wires 100 and 111 to fixed contact N21. Fixed contact M14 is connected by wire 101 to fixed contact N14. Fixed contact M16 is connected by wire 102 to fixed contact N12 and by wires 102 and 109 to fixed contact M21.

One end of coil M26 is connected to plus power supply and the other end is connected by wire 112 to fixed contact N24. One end of coil M27 is connected to plus power supply and the other end by wire 114 to switch arm M19. Switch arm M17 is connected by wire 113 to one end of coil M28, the other end of said coil being connected to plus power supply.

Coil N26 is connected at one end to plus power supply and at the other end by wire 110 to fixed contact M24. Coil M27 is connected at one end to plus power supply and at its other end by wire 118 to switch arm N19.

The fixed contacts M32, M34, N32 and N34 are connected to minus power supply. Switch arm M33 is connected by wire 123 to the coil of operating relay M3 and switch arm N33 is connected by wire 124 to the coil of operating relay N3. Switch arm N13 is connected to minus power supply. Switch arm N17 is connected by wire 117 to one end of coil N29, the other end of said coil being connected to plus power supply.

The operation of the circuit interconnecting the treadles M and N will now be described when a vehicle axle passes over the treadles in the center lane closing treadle M first, and then treadle N.

Upon closing treadle switch M, relay M8 will be energized, the circuit being minus power supply through treadle switch M, wires 119 and 120, coil M9 to plus power supply. Relay M25 is also energized by the closure of said switch, the energizing circuit being from minus power supply, wire 119, switch N23—N24, wire 112, coil M26 to plus power supply.

As the vehicle wheels progress along the center lane, treadle switch N is also closed energizing relay N8, the circuit being from minus power supply through treadle switch N, wires 115 and 116, coil N9, to plus power supply. The closing of treadle switch N also completes a circuit through coil M27 of relay M25, the circuit being from plus power supply, coil M27, wire 114, switch M19—M21, wires 109 and 102, switch N11—N12, wires 106 and 105, switch M31—M32 to minus power supply.

As the vehicle continues, treadle switch M is released thereby breaking the circuit for coil M9 and releasing relay M8. The circuit for coil M26 of relay M25 is also opened by release of said treadle switch, but relay M25 is held energized by the influence of coil M27. As relay M8 becomes de-energized, switch M15—M16 closes and completes a holding circuit for coil M27, the circuit being from plus power supply, coil M27, wire 114, switch M19—M21, wires 109 and 102, switch M15—M16, wire 105, switch M33—M34 to minus power supply.

As the wheels of a vehicle roll off treadle N, relay N8 becomes de-energized. Relay M25 remains energized due to the above-mentioned holding circuit. The release of relay N8 completes a circuit through coil M29 of relay M28, the circuit being from plus power supply, through the coil M29, wire 113, switch M17—M18, wires 108 and 104, switch M13—M14, wire 101, switch N13—N14, to minus power supply. Energizing relay M28 will close switch M33—M34 to energize the operating relay M3, the circuit being from minus power supply through said switch and wire 123 to the coil of the operating relay. Switch M31—M32 opens de-energizing relay M25, in turn de-energizing the relay M28.

By closing switch M33—M34 and energizing the operating relay M3, the counting circuit will be operated to actuate the counter E in the manner heretofore described.

In a similar manner counter RE will be actuated when a vehicle passes over the center lane in the opposite direction closing the treadle switch N and then treadle switch M. Switch N33—N34 will close energizing the operating relay N3, thereby operating the counting circuit to actuate the counter RE.

It will be seen, therefore, that all vehicle axles moving in one direction, whether moving on a uni-directional lane, or on the two-directional lane, will register the passage of said axles on the totalizing counter E; and that all vehicle axles moving in the opposite direction, whether moving on the other uni-directional lane or on the two-directional lane, will register the passage of said axles on the totalizing counter RE.

It will also be understood that the directional totalizing circuit illustrated in Fig. 3, and herein described, can be expanded to include a combination of any number of uni-directional lanes carrying traffic in one direction, any number of uni-directional lanes carrying traffic in the opposite direction, and any number of two-directional lanes. For a plurality of two-directional lanes, the circuit interconnecting the treadle switches M and N is multiplied for each additional lane and switch M33—M34 is connected to an added station in the counting circuit of counter E and switch N33—N34 is connected to an added station in the counting circuit of counter RE.

It will furthermore be noted that the directional counting circuit illustrated in Fig. 3 may be used to count every other vehicle axle instead of every axle. In such case, the additions made to the circuit of Fig. 1 and illustrated by Fig. 2, are made in the circuit as disclosed. The first closure of switch M33—M34 or N33—N34 would energize the first of the operating relays, and the subsequent opening of said switch energizing the other operating relay. The second closure of switch M33—M34 or N33—N34 energizes the primary relay thereby operating the respective counting circuits.

It will thus be seen that there is provided a device 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 embodiments above set forth, it is to be understood that all matter herein described, or shown in the accompanying drawings is 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, a plurality of switches, an electromagnetic counter having an electromagnet, means to energize the electromagnet once for each actuation of any of said switches when the period between actuations of different switches is either greater or less than the time it takes for the counter to operate in making a count, and including means to prevent more than one energization of said electromagnet upon actuation of a switch, irrespective of the duration of actuation of that switch.

2. In apparatus for checking the traffic on a highway having more than two lanes, a treadle for each lane of the highway, adapted to be actuated by vehicles passing along said lane, a counting means including an electromagnet, means to energize said electromagnet upon actuation of any of said treadles, when said treadles are actuated either alone or substantially simultaneously and to prevent making a count on said counting means upon actuation of any treadle if said treadle is not restored to initial condition, and including means to prevent more than one count on said counting means upon actuation of a treadle irrespective of the duration of actuation thereof.

3. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet upon actuation of any of said switches, when said switches are actuated either alone or substantially simultaneously and including means to prevent more than one energization of said electromagnet by the actuation of said switches irrespective of the duration of actuation of said switches.

4. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet upon actuation of any of said switches, when said switches are actuated either alone or substantially simultaneously and including means to prevent more than one energization of said electromagnet by the actuation of said switches irrespective of the duration of actuation of said switches, and including means to energize said electromagnet each time a switch is actuated while another switch remains in actuated condition.

5. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet upon actuation of any of said switches, when said switches are actuated either alone or substantially simultaneously and including means to prevent more than one energization of said electromagnet by the actuation of said switches irrespective of the duration of actuation of said switches, and including means to energize said electromagnet each time a switch is actuated while one or more of the other switches remain in actuated condition.

6. In combination, a plurality of switches, an electromagnetic counter, a circuit interconnecting said switches and said counter, including a primary and a secondary relay for each switch, means for energizing each primary relay upon actuating its switch, means to hold said primary relays energized upon release of their switches, means to energize said secondary relays upon energizing the primary relays associated therewith and release of their respective switches, means to release the primary relays upon energizing their secondary relays, and means to actuate said electromagnetic counter upon release of an energized primary relay.

7. In combination, a plurality of switches, an electromagnetic counter, a circuit interconnecting said switches and said counter, including a primary and a secondary relay for each switch, means for energizing each primary relay upon actuating its switch, means to hold said primary relays energized upon release of their switches, means to energize said secondary relays upon energizing the primary relays associated therewith and release of their respective switches, means to release the primary relays upon ener-

gizing their secondary relays, means to actuate said electromagnetic counter upon release of an energized primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being actuated should more than one switch be actuated substantially simultaneously, until the secondary relay which has been energized releases its primary relay resulting in actuation of the counter, thereby permitting another secondary relay to be energized to release its primary relay for causing another actuation of said counter.

8. In combination, a plurality of switches, an electromagnetic counter, a circuit interconnecting said switches and said counter, including a primary and a secondary relay for each switch, means for energizing each primary relay upon actuating its switch, means to hold said primary relays energized upon release of their switches, means to energize said secondary relays upon energizing the primary relays associated therewith and release of their respective switches, means to release the primary relays upon energizing their secondary relays, means to actuate said electromagnetic counter upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being actuated should more than one switch be actuated substantially simultaneously, until the secondary relay which has been energized releases its primary relay resulting in actuation of the counter, thereby permitting another secondary relay to be energized to release its primary relay for causing another actuation of said counter, and means for releasing the primary relays upon energizing the secondary relays including means to prevent release of the primary relays unless the switches associated with said primary relays have been previously released.

9. In combination, a plurality of switches, an electromagnetic counter, a circuit interconnecting said switches and said counter, including a primary and a secondary relay for each switch, means for energizing each primary relay upon actuating its switch, means to hold said primary relays energized upon release of their switches, means to energize said secondary relays upon energizing the primary relays associated therewith and release of their respective switches, means to release the primary relays upon energizing their secondary relays, means to actuate said electromagnetic counter upon release of a primary relay, means controlled by said primary and secondary relays to prevent more than one secondary relay from being actuated should more than one switch be actuated substantially simultaneously, until the secondary relay which has been energized releases its primary relay resulting in actuation of the counter, thereby permitting another secondary relay to be energized to release its primary relay for causing another actuation of said counter, the means for releasing the primary relays upon energizing the secondary relays including means to prevent release of the primary relays unless the switches associated with said primary relays have been previously released, and including means to prevent more than one count on said counter upon actuation of a switch irrespective of the duration of actuation of said switch.

10. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon de-energizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, and means to energize said electromagnet upon release of a primary relay.

11. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet.

12. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, and means to energize said electromagnet upon release of a primary relay, the means for releasing the primary relays upon energizing their respective secondary relays including means to prevent release of the primary relay unless the operating relays associated with said primary relays have been previously de-energized.

13. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays

upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, and said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches.

14. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating the switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches, and including means to energize said electromagnet when one or more of said switches are actuated while another switch remains in actuated condition.

15. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays including means to prevent release of the primary relays unless the operating relays associated with said primary relays have been previously de-energized.

16. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, and means to energize said electromagnet upon release of a primary relay, means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays including means to prevent release of the primary relays unless the operating relays associated with said primary relays have been previously de-energized, and said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches.

17. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, a circuit interconnecting said switches and said electromagnet, including an operating relay, a primary relay, and a secondary relay for each of said switches, means for energizing each operating relay upon actuating its switch, means to energize the primary relays upon energization of their respective operating relays, means to hold said primary relays energized upon de-energization of their respective operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays including means to prevent release of the primary relays unless the operating relays associated with said primary relays have been previously de-energized, means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches, and said circuit including means to energize said electromagnet when one or more of said switches are actuated while another switch remains in actuated condition.

18. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet once upon actuation of any of said switches a predetermined plurality of times, when said switches are actuated either alone or substantially simultaneously, and including means to prevent more than one energization of said electromagnet by actua-

tion of one of said switches said predetermined plurality of times irrespective of the duration of actuations of said switch.

19. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet once upon actuation of any of said switches a predetermined plurality of times, when said switches are actuated either alone or substantially simultaneously, and including means to prevent more than one energization of said electromagnet by actuation of one of said switches said predetermined plurality of times irrespective of the duration of actuations of said switch, and including means to energize said electromagnet once when any of said switches are actuated said plurality of times while another switch remains in actuated condition.

20. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit connecting said switches and said electromagnet, said circuit comprising means to energize said electromagnet once upon actuation of any of said switches a predetermined plurality of times, when said switches are actuated either alone or substantially simultaneously, and including mean to prevent more than one energization of said electromagnet by actuation of one of said switches said predetermined plurality of times irrespective of the duration of actuations of said switch, including means to energize said electromagnet once when any of said switches are actuated said plurality of times while another switch remains in actuated condition, and including means to energize said electromagnet once when any of said switches are actuated said plurality of times while one or more of the other switches remain in actuated condition.

21. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, and means to energize said electromagnet upon release of a primary relay.

22. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize said electromagnet upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet.

23. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize the electromagnet upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays being operative only if the operating relays associated with said primary relays have been previously de-energized.

24. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize the electromagnet upon release of a primary relay, and means controlled by said primary and secondary relays to prevent more than one secondary relay

from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays being operative only if the operating relays associated with said primary relays have been previously de-energized, and said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches.

25. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize the electromagnet upon release of a primary relay, means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relay, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays being operative only if the operating relays associated with said primary relays have been previously de-energized, said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches, and including means to energize said electromagnet when one or more of said switches are actuated while another switch remains in actuated condition.

26. In combination, a plurality of switches, an electromagnetic counter having an electromagnet, and a circuit interconnecting said switches and said electromagnet, including a pair of operating relays for each switch, whose coils are connected in series; a primary and a secondary relay for each of said switches, means for energizing one of said pair of operating relays upon actuating its switch, means for energizing the other of said pair of operating relays upon the subsequent opening of its switch, means to energize the primary relays upon the subsequent closure of its switch, means to hold said primary relays energized upon de-energization of their respective pair of operating relays, means to energize said secondary relays upon deenergizing the operating relays associated therewith, means to release the primary relays upon energizing their respective secondary relays, means to energize the electromagnet upon release of a primary relay, means controlled by said primary and secondary relays to prevent more than one secondary relay from being energized should more than one switch be actuated substantially simultaneously until the secondary relay which has been energized opens its primary relays, resulting in the energization of the electromagnet, thereby permitting another secondary relay to be energized to open its primary relay for causing another energization of said electromagnet, the means for releasing the primary relays upon energizing their respective secondary relays being operative only if the operating relays associated with said primary relays have been previously de-energized, and said circuit including means to prevent more than one energization of said electromagnet by actuation of said switches, irrespective of the duration of actuation of said switches, and including means controled by the second of said operating relays of each pair of said relays, to permit the energization of the secondary relays associated with the remaining switches, while one or more other switches remain actuated.

27. In a traffic counting system, two single switch treadles and a multi-switch treadle, each adapted to be disposed in separate lanes of a highway and actuated by the wheels of vehicles as they roll over said treadles, a pair of counters, each of said counters having an electromagnet, means to energize the first of said electromagnets for all actuations of the first single switch treadle and multi-switch treadle actuated by vehicles going in one direction, and means to energize the other of said electromagnets for all actuations of the other single switch treadle and the multi-switch treadle actuated by vehicles going in an opposite direction.

28. In a traffic counting system, two single switch treadles and a multi-switch treadle, each adapted to be disposed in separate lanes of a highway and actuated by the wheels of vehicles as they roll over said treadles, a pair of counters, each of said counters having an electromagnet, means to energize the first of said electromagnets for all actuations of the first single switch treadle and multi-switch treadle actuated by vehicles going in one direction, and means to energize the other of said electromagnets for all actuations of the other single switch treadle and the multi-switch treadle actuated by vehicles going in an opposite direction, when said switches are actuated either alone or substantially simultaneously.

29. In a traffic counting system, two single switch treadles and a multi-switch treadle, each adapted to be disposed in separate lanes of a highway and actuated by the wheels of vehicles as they roll over said treadles, a pair of counters, each of said counters having an electromagnet, means to energize the first of said electromagnets for all actuations of the first single switch treadle and multi-switch treadle actuated by vehicles going in one direction, means to energize the other of said electromagnets for all actuations of the other single switch treadle and the multi-switch treadle actuated by vehicles going in an opposite direction, when said switches are actuated either alone or substantially simultaneously, and means included in said first and second mentioned means to prevent energization of said electromagnets upon actuation of their respective single switch treadles irrespective of the duration of actuation of said treadles.

30. In a traffic counting system, two single switch treadles and a multi-switch treadle, each adapted to be disposed in separate lanes of a highway and actuated by the wheels of vehicles as they roll over said treadles, a pair of counters, each of said counters having an electromagnet, means to energize the first of said electromagnets for all actuations of the first single switch treadle and multi-switch treadle actuated by vehicles going in one direction, means to energize the other of said electromagnets for all actuations of the other single switch treadle and the multi-switch treadle actuated by vehicles going in an opposite direction, when said switches are actuated either alone or substantially simultaneously, means included in said first and second mentioned means to prevent energization of said electromagnets upon actuation of their respective single switch treadles irrespective of the duration of actuation of said treadles, and said first and second mentioned means also including means to permit energization of the electromagnets each time their respective single switch treadles are actuated when one or more of the remaining treadles interconnected therewith remain in actuated condition.

BENJAMIN COOPER.