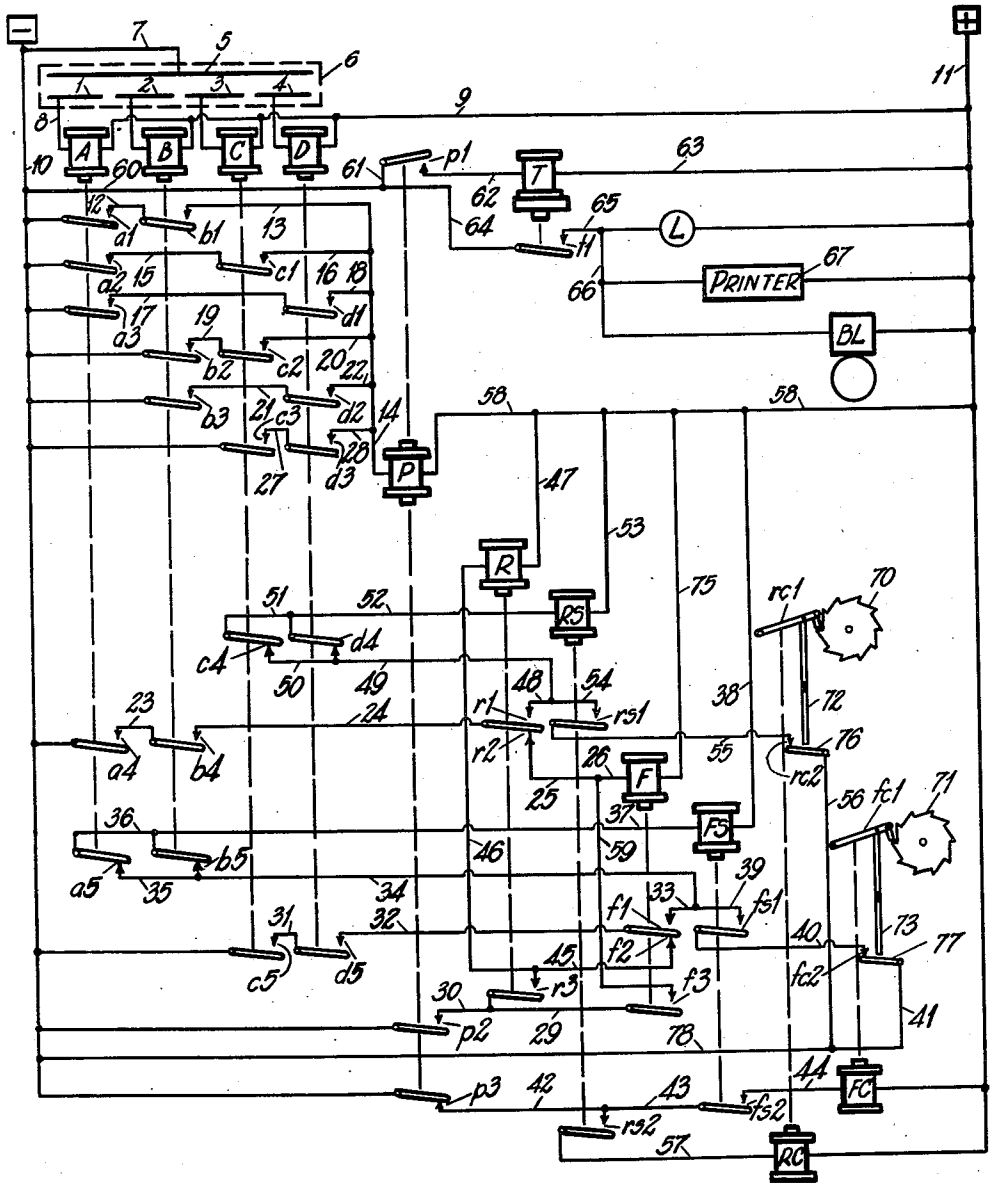
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CONTROL SYSTEM

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CONTROL SYSTEM

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This invention relates generally to a control system for operating counting devices or indicating devices and the like. More particularly the invention relates to indicating or registering apparatus responsive to concurrent closure of two or more switches for more than a predetermined time in a multiple switch control system having the switches normally operated in overlapping sequence and more specifically relates to such apparatus in a control system employing a multiple switch treadle and a group of relays actuated thereby to operate counting devices only responsive to actuation of the multiple switches in an overlapping sequence.

This application is a division of my copending application, Serial Number 327,020, filed March 30, 1940, for "Control system."

Control systems of this character are particularly useful in the counting of road vehicle traffic at toll checking points for example where a multicontact treadle in the roadway is actuated by a vehicle wheel rolling over its contacts in sequence and it is desired to operate one counter for recording vehicles passing in a forward direction and another counter for vehicles passing in the reverse direction, and where it is desired to have the mounting of vehicle axles as accurate as possible and substantially free of actuation by pedestrians or toll collectors on random closure of one or more of the treadle contacts.

Toll checking systems are ordinarily arranged to count the number of axles and in some cases supplementary manual classification is made of the various types of vehicles having different numbers of axles. In some instances the toll rate is related to the number of axles, and in the case of restricted roads such as parkways the traffic is frequently limited to the two axle pleasure vehicle.

An object of this invention is to provide an indicating device responsive to the concurrent closure of two or more switches for more than a predetermined time limit in a control system of the character described.

Referring now to the drawing negative and positive power supply wires 10 and 11 are shown at the left and right sides.

A multiple switch treadle 6 is shown schematically in cross section in the upper part of the drawing, with the several switch contacts 1, 2, 3 and 4 arranged side-by-side and adapted to engage contact plate 5 individually when actuated. The treadle 6 is shown in the drawing with the common plate 5 over the contact plates 1, 2, 3 and 4 for simplicity of illustration in the drawing, but is preferably placed in the surface of a roadway with the plates 1, 2, 3 and 4 over the common plate 5. Four separate plates may be used in place of the common plate 5 so that both upper and lower plates are entirely separate switches if desired, but in any case the four switches in the treadle 6 are spaced so closely side-by-side that a vehicle wheel rolling over the treadle will close the switches in an overlapping sequence in which at least three switches are closed concurrently.

The four switch treadle 6 may be made with the assembly of switches all sealed in an outer envelope of rubber or other flexible insulating material or a rubber covering for the plates 1, 2, 3, 4 may be bonded to plate 5 and the latter made more rigid where the plate 5 is under plates 1, 2, 3, 4 for example. The plates 1, 2, 3, 4, 5 are preferably of relatively narrow width and considerable length extending across a traffic lane in the case of use with road traffic for example and the plates 1, 2, 3 and 4 are kept properly spaced laterally from each other preferably by separation strips of rubber and these plates may be maintained normal separated from plate 5 by employing resilient separation strips or by employing other very narrow separation strips extending transversely across the several plates and spaced at intervals along the length of the treadle.

The narrower plates 1, 2, 3 and 4 are preferably resilient and the separation strips are narrow enough to permit the individual plates to flex on either side into contact with the bottom common plate even though the tire of the vehicle wheel rides directly over the separation strip.

The details of construction of the treadle are in general immaterial to the subject matter of the present control system except that the system is designed for operation by an overlapping sequence of closure of the treadle switches as will be more fully described below.

In the case of a wheel rolling from left to right, which is hereafter referred to as the forward direction, plate 1 will first contact with plate 5, then plate 2 will contact with plate 5 while 1 and 5 remain in contact, then plate 3 contacts with plate 5 while 1 and 2 are in contact with 5. Next plate 4 contacts with plate 5 and finally plates 2, 3 and 4 break contact with plate 5 in succession as the wheel continues to roll forward and off the treadle. It is not essential that all four plates 1, 2, 3 and 4 be in contact with plate 5 concurrently but the four switches must be closed in sequence with a progressive overlap of closure of at

least three switches for proper operation of the complete system.

In the case of a wheel rolling over the treadle from right to left (reverse direction) the plate 4 is first brought into contact with plate 5 and then 3, 2, and 1 contact with 5 in sequence, with the plates separating in the order 4—3—2—1, and with overlap of contact of plates 4, 3, and 2 with 5 and then overlap of contact of 3, 2 and 1 with 5 in order during the sequence.

Shown below the plates 1, 2, 3, 4 in the drawing is a group of relays A, B, C, D connected to the respective plates, so that each relay will be operated individually when its associated plate is in contact with plate 5.

The common plate 5 is connected to negative power by wire 7 and relay A is connected on one side via wire 8 to switch 1 and on the other side via wire 9 to positive power so that relay A is energized whenever switch 1—5 is closed. Relays B, C, and D are similarly connected to plates 2, 3 and 4 respectively to be energized by closure of switches 2—5, 3—5 and 4—5 respectively, the right side of the relays being connected to wire 9.

The relays A, B, C and D when operated in the proper sequence operate relay P and in cooperation with relay P operate the relays R and RS for a wheel rolling in the reverse direction or operate the relays F and FS for a wheel going in the forward direction. The relay RS operates the electro-magnetic counter or other electrical device RC for actuation in the reverse direction and the relay FS operates the similar counter or electrical device FC for actuation in the forward direction.

The relay P is operated by concurrent closure of any two of the contacts 1, 2, 3, 4 and in turn operates a retarded pickup time delay relay T to operate an alarm lamp L, a printer 67 and a bell BL if the concurrent contact closure persists more than the time delay interval for which the relay T is set. The time may be of the order of several seconds for example and the time relay T is preferably of the quick reset type.

Time delay relay devices of the type in which a condenser is charged through a control resistance to a predetermined voltage to operate an electronic tube and relay are particularly suited to this timing operation, and an example is disclosed in the Patent 1,909,471 issued to F. G. Kelly, Jr.

The printer 67 indicated schematically in the drawing would ordinarily be of electro-magnetic type to print a record, at the side of the timed traffic count record tape, used in toll checking for example, of the instances of excessive time of concurrent actuation of two or more switches of the treadle. Any one or more of the several forms of alarm devices such as lamp L, printer 67, or bell BL may be omitted if desired.

The relay A has four make contacts *a1* to *a4* inclusive which are closed when the relay is energized and restore to normal open position when the relay is deenergized, and this relay also has one break contact *a5* which is normally closed when the relay is deenergized and is opened when the relay is energized.

Similarly relay B has four make contacts *b1* to *b4* inclusive and one break contact *b5*, relay C has four make contacts *c1*, *c2*, *c3*, *c5* and one break contact *c4*, and relay D has four make contacts *d1*, *d2*, *d3*, *d5* and one break contact *d4*.

Relay P has two make contacts *p1* and *p2* and one break contact *p3*. Relay R has two make contacts *r1* and *re* and one break contact *r2*, and relay RS has two make contacts *rs1* and *rs2*. Relay F has two make contacts *f1* and *f3* and one break contact *f2*, and relay FS has two make contacts *fs1* and *fs2*. Relay T has one make contact *t1*.

Electromagnetic devices RC and FC are shown as counters, the coils RC and FC operating the armatures *rc1* and *fc1* respectively to actuate the respective counter ratchet wheels 71 and 70, and to open the contacts *rc2* and *fc2* respectively upon actuation of the counter wheel. The bar 72 is connected to armature *rc1* to actuate arm 76 to open contact *rc2* only when the counter ratcheting armature *rc1* has been pulled down far enough by the coil RC to assure advance of the counter wheel 70 one digit. Bar 73 serves a similar purpose on arm 77 to open contact *fc2* when coil FC is energized to advance counter wheel 71.

The counter ratchet arrangements are shown with the counter advanced one step on the energizing stroke of the armatures *rc1* and *fc1* but it will be appreciated that the ratchet arrangement could be reversed if desired to have the armature take the next tooth of the ratchet wheel on the energizing stroke and advance the ratchet wheel on the return stroke by spring action.

All of the armatures and contacts of the several relays and electromagnetic devices are shown in their normal deenergized condition in the drawing as in the absence of treadle actuation, and these elements are restored to their normal condition by spring action or other suitable methods.

It will be understood that other contacts may be added if desired to the electromagnetic devices RC and FC, the relay T or other relays for operation of indicating devices or the like, or the armatures *rc1* and *fc1* may be arranged to operate contacts for signalling circuits if it is desired to use the control system of the invention for signalling instead of counting.

Considering now the operation of the system in more detail responsive to actuation of the treadle switches by a rolling wheel for example, assume first the wheel rolls over the treadle in the forward direction, actuating the switches in the order 1—2—3—4.

Plate 1 first engages plate 5 and completes a circuit from negative power wire 10 via wire 7, plate 5, plate 1, wire 8 relay A wire 9 to positive power wire 11, thus energizing relay A and causing the latter to close its make contacts and open its break contact *a5*. Next plate 2 engages plate 5 while plate 1 is still engaged with plate 5 by the pressure of the wheel, and this closes a circuit from negative power via wire 7, plates 5 and 2, relay B and wire 9 to positive power, thus energizing relay B while relay A remains energized.

With relays A and B now both energized one of a group of several circuits for energizing relay P is completed via contacts *a1* and *b1*. These several circuits for relay P involve different pairs of the first three contacts of the relays A, B, C, and D in combinations of two at a time. In each case the circuit through the pair of contacts connects negative power via wire 14 to relay P and the other side of relay P is connected via wire 58 to positive power.

The first of these circuits for relay P includes contact *a1* wire 12, contact *b1* and wire 13 to wire 14 and relay P, and is completed to energize relay P as soon as the wheel has rolled onto plates 1

and 2 as stated above, and relay P closes its make contacts $p1$ and $p2$ and opens its break contact $p3$.

Closure of contact $p1$ completes a circuit from negative power via wires 60, 61, contact $p1$, wire 62, relay T, but relay T is of the retarded operating time delay type and will close its contact $t1$ only after continuous energization for a predetermined time period of several seconds for example provided relay P is continuously energized for such time period. In the latter case relay T closes its contact $t1$ and completes a circuit via wires 60, 64, contact $t1$, wire 65 to alarm lamp L, and via wire 66 to alarm bell BL, and printer 67, as previously described.

Under normal conditions of operation by a vehicle wheel however the wheel moves over the treadle quite rapidly and the relay P and relay T are not energized sufficiently long to permit time delay relay T to operate its contact $t1$.

Returning to the sequence of operations as the wheel continues to roll forward over the treadle, the operation of contacts $p2$ and $p3$ by energization of relay P by closing of contacts $a1$ and $b1$ has no immediate effect and the significance will be described subsequently below.

With the concurrent actuation of plates 1 and 2 and energization of relays A and B, the closure of contacts $a4$ and $b4$ completes a circuit for relay F from negative power via contact $a4$, wire 23, contact $b4$, wire 24, break contact $r2$ of relay R (now deenergized), wires 25, 26, relay F, wires 75 and 58 to positive power, thus energizing relay F.

Relay F is held energized by a lock-in circuit from wire 26 at relay F via wire 59, contact $f3$, wires 29, 30 and contact $p2$ of relay P to negative power, so that after the wheel rolls forward enough to open switch 1—5 and deenergize relay A and interrupt the initial operating circuit of relay F at contact $a4$ the relay F will remain energized as long as relay P remains energized.

As the wheel continues to roll forward so as to bring plate 3 into contact with plate 5 the relay C is energized from negative power via plate 5, and the break contact $c4$ of relay C is opened and the remaining make contacts are closed. Now relays A, B, and C are concurrently energized.

Another energizing circuit for relay P has been completed via contact $b2$, wire 19, contact $c2$ and wire 20 to wire 14. The latter circuit will hold relay P energized during the next step in the sequence when the wheel has rolled further to release plate 1 from plate 5 and thus deenergize relay A and open contact $a1$ and $a2$.

The auxiliary energizing circuits for relay P via contacts $a2$ and $c1$ and wires 15 and 16 to 14, and via contacts $a3$ and $d1$ and wires 17 and 19 to wire 14, and via contacts $b3$ and $d2$ and wires 21 and 22 to wire 14 are primarily for operation of the alarm devices through relay T in case two of the plates should become permanently closed or remain closed more than the predetermined time limit of relay T, and these auxiliary circuits are not required in connection with the counter operating relay system in the normal rolling wheel-sequence.

Relay F at contact $f1$ has prepared a circuit for energization of relay FS as soon as relays C and D are energized and relay A or relay B is deenergized, which occurs when the wheel has rolled forward far enough to release plate 1 from plate 5 and to engage plates 2, 3 and 4 with plate 5.

Under these conditions a circuit to energize relay FS is completed from negative power via contact $c5$, wire 31, contact $d5$, wire 32, contact $f1$, wire 33, wires 34, 35, contact $a5$, wires 36, 37, relay FS, wires 38, 58 to positive power, and relay FS closes its contacts $fs1$ and $fs2$.

The relay FS now has a holding circuit completed from negative power via wires 76, 41, arm 77, contact $fc2$ of the electromagnetic counter FC, wire 40, contact $a5$ and wires 36, 37 to relay FS. Contact $b5$ of relay B will also serve to maintain this holding circuit when the wheel rolls far enough to deenergize relay B as plate 2 is released from plate 5.

Now the wheel is holding only plates 3 and 4 in contact with plate 5 and relay P is held energized only by a circuit from negative power via contact $c3$, wire 27, contact $d3$, wire 28 to wire 14 and relay P, and as the wheel rolls off of plate 3 so that only plate 4 is held in contact with plate 5, relay C is deenergized and opens its contact $c3$, which deenergizes relay P. Thus contact $p3$ of relay P closes and completes a circuit from negative power via contact $p3$, wires 42, 43, contact $fs2$, wire 44 through coil FC to positive power. This energizes the coil FC and pulls down armature $fc1$ to advance the counter ratchet 71 one count and by insulated bar 73 opens contact $fc2$. This in turn interrupts the holding circuit of relay FS and deenergizes relay FS to open contact $fs2$ and deenergize coil FC and restore the armature $fc1$ to its upper position to prepare for any subsequent counting action.

The deenergization of relay P as the wheel released plate 3 also opened contact $p2$ to interrupt the holding circuit of relay F and deenergize the latter.

As the final step in the forward rolling sequence the wheel moves off the treadle releasing plate 4 and deenergizing relay D so that the apparatus is all restored to the normal condition illustrated in the drawing.

It will be observed that by the use of series circuits through the make contacts of relays A—B and relays C—D and by parallel circuits through the break contacts such as $a5$—$b5$ of these relay pairs the permanent closure of any one of the plates 1, 2, 3 and 4 against plate 5 by failure or otherwise or the grounding of any one of the plates to relay circuits of relays A, B, C, D to negative power will not interrupt the proper operation of the relays F and FS to cause a forward count, nor will this as subsequently described interrupt proper operation of relays R and RS to cause a reverse count. Relay F will be energized as plate 2 is operated to close contact $b4$ by the wheel rolling forward for example, and relay FS will be energized as the plate 2 is released by the wheel to close contact $b5$, even if relay A alone were permanently energized for example.

However, if relay B alone were permanently energized relay F would be energizd by contact $a4$ upon actuation of plate 1 and relay FS would be energized by contact $a5$ upon release of plate 1 in the forward direction the operation of relays C and D remaining the same as usual as previously described for the forward direction.

If relay C alone should be permanently energized, the relays F and FS would be energized as usual in the forward direction. In any case if any one of the relays A, B and C alone was permanently energized the counter FC would not be operated until the wheel rolled entirely off the treadle to release plate 4 and relay D and interrupt the last circuit for relay P and release relay P so as to complete the counter operating circuit at contact $p3$. This merely delays the count

momentarily but does not prevent a proper count, the forward count being completed via contact *fs2* to energize coil FC and release relay FS at contact *fc2* to release coil FC at contact *fs2* as previously described.

Now considering a wheel rolling in the reverse direction actuating the plates in the order 4—3—2—1, relay D is first energized as plate 4 is actuated. Then relay C is next energized as plate 3 is also actuated, and relay P is energized by contacts *c3* and *d3* over the circuit previously described. As the wheel continues over plates 2 and 1 the relay P is held energized by the pairs of contacts of relays C and B and those of relays B and A.

With relays D and C both energized when the wheel rolling in reverse direction has actuated plates 4 and 3, a circuit is completed to energize relay R, from negative power via contact *c5*, wire 31, contact *d5*, wire 32, contact *f2*, wires 45, 46, through relay R and wires 47, 58 to positive power. Relay R thus closes its contact *r3* providing a holding circuit from negative power via contact *p2* wire 30, contact *r3*, wire 46 to relay R. Relay R also prepares a circuit for energizing relay RS as soon as the wheel has rolled in reverse direction sufficiently to operate plates 2 and 1 and relays B and A and to release plate 4 or plate 3, and relay D or C the circuit for relay RS being then completed from negative power via contact *a4*, wire 23, contact *b4*, wire 24, contact *r1*, wires 48, 49, contact *d4* (or wire 50, contact *c4*, wire 51), wire 52, through relay RS, wires 53, 58 to positive power.

Relay RS now completes its holding circuit via its contact *rs1* and contact *rc2* of the reverse counter, wires 56, 78 to negative power, the holding circuit also including contacts *c4* and *d4* in parallel.

As soon as the wheel has rolled far enough to release all but plate 1 and relay A, the last circuit for relay P is interrupted and contact *p3* closes completing a circuit via contact *rs2* to the reverse electromagnetic device RC so that the armature *rc1* will be pulled down to operate the reverse counter ratchet 70, and the insulated bar 72 will operate arm 76 to open contact *rc2* to interrupt the holding circuit of relay RS and release this relay to open its contact *rs2* to deenergize the coil RC and release armature *rc1* to prepare for any subsequent reverse count.

As in the case of the forward direction the circuits for the reverse direction are arranged to permit proper counting with any one of the relays A, B, C, and D permanently energized, the operating circuits employing parallel contacts *c4* and *d4* for relay RS and series contacts *c5* and *d5* for relay R.

In the case of an axle counting system for toll checking the treadle is placed a short distance beyond the toll station so as that the car wheels will cross the treadle after toll is paid and the car moves forward in leaving the toll station. However, the restriction of the traffic lanes at and near the toll station to permit cars passing around or crossing lanes extends for only a short distance and the treadles cannot be placed very far beyond the station. For this reason car drivers sometimes overrun the station somewhat and actuate the treadle in a forward direction and then back up to pay toll, again proceeding forward over the treadle after paying toll.

The present construction provides for this condition by the count in both the reverse and forward directions so that the forward count less the reverse count provides an accurate net forward count.

Another problem in toll check counting is that the front wheels of a car may roll partway onto the treadle. Such a condition is sometimes also caused by the toll collector's recalling the driver on account of an error in change or some other question about the money or the driver returns to ask some question.

It is a feature of the present construction that such rolling back and forth will not interfere with a correct net forward count. The forward preparatory relay F and the reverse preparatory relay R are interlocked electrically by having the initial energizing circuit of each pass through a break contact of the other, F being energized through contact *r2* and R being energized through contact *f2*, so that the initial operation of one prevents the operation of the other until the first has released again on completion of the appropriate count. Whichever of relays F and R is energized, is locked in over a holding circuit via make contact *p2* of relay P as previously described. Also the completion of the operating circuits to the respective counters depends on closure of break contact *p3* of relay P.

Thus as long as any two of the plates remain actuated as the wheel rolls back and forth then relay P will remain energized over one of the several circuits of the first four sets of contacts of relays A, B, C, D, and whichever relay R or F is operated will remain locked in and the other locked out, and neither counter will be operated. The counter will be operated only by the rolling of the wheel off all but one plate in the original direction so as to release relay P which in turn will operate the appropriate counter and will also release whichever relay R or F was energized by the initial movement in the original direction. Since the counter also is reset to normal by releasing relay FS or RS as the case may be, the system is then ready to operate for another count.

It will be observed that both the initial energizing circuit and the holding circuit for the relay FS include break contacts *a5* and *b5* on relays A and B, and both such circuits for relay RS include break contacts *c4* and *d4* on relays C and D, as previously described. Thus if a wheel rolls forward to actuate plates 3 and 4 and release plate 1 the relay FS will be initially energized as previously described by way of contact *f1* of the preparatory relay F, but if the wheel then rolls backward to reactuate plate 1 the relay contact *a5* will again open and since contact *b5* is also open the relay FS will become deenergized again. No count will then have been made since relay P has remained energized and contact *p3* open. If the wheel continues backward off the treadle, or off all but plate 1, the relay P will then be released and also the relay F so that the system will be ready for the next count in either direction, so that if the wheel now again rolls forward across the treadle completely only one forward count and no reverse count will be recorded.

If however the wheel should initially roll forward far enough to release all but the last plate and cause a forward count, and then roll backward but not far enough to release all but the first plate and then forward again, no reverse count will be recorded because relay contact *p3* will remain open and relay RS will be released by contacts *c4* and *d4* reopening on the final

forward movement and only the first forward count will be made.

It will be appreciated that although four switches 1, 2, 3, 4 and four corresponding relays A, B, C, D are employed in the present embodiment this is merely illustrative of the preferred arrangement, and more than four switches could readily be employed side-by-side and additional relays connected thereto in similar manner to relays A, B, C, D and additional contacts and circuits for relay P provided similar to those illustrated. The additional plates may conveniently be arranged between plates 2 and 3 for example and the additional relays arranged between relays B and C without changing any of the circuits for relays F, R, FS, and RS if desired except that in such case the plates must be narrow enough and closely spaced enough so that the wheel will operate three adjacent plates concurrently as at present.

If desired, however, the circuits for relays F, R, FS and RS involving the series contacts *a*4, *b*4 and *c*5, *d*5 and the parallel contacts *a*5, *b*5 and *c*4, *d*4 could be extended to include additional series or parallel contacts respectively on adjacent relays so that three adjacent plates must be operated concurrently to complete the initial operating circuits for relays F, R, FS and RS and the circuits of relay P could similarly be extended over three contacts so that energization of relay P would require actuation of three plates concurrently instead of two. This arrangement would permit the permanent closure of any two plates and still provide proper counting. In such arrangement the plates would preferably be narrower and more closely spaced if more than four plates are used.

It will also be appreciated that the fourth plate 4 and relay D could be omitted if desired to provide a three switch treadle employing plates 1, 2 and 3 and relays A, B and C in which case the contacts *d*4 and *d*5 would be transferred to relay B, and the circuits would operate as previously described, the system providing the forward and reverse counting and protective features already described for the four switch treadle arrangement.

It will therefore be observed that the principles of the present circuit arrangement in accordance with the invention provide the basis for considerable variation in the number of plates and relays and further flexibility of design.

It will be understood that other rearrangements or substitutions may be made in the various parts of the system without departing from the spirit of the invention as defined by the claims.

Where the concurrent actuation of more than two plates, or at least three plates, or three or more plates is stated as required herein it will be understood that the operation of the system depends on having not less than two plates actuated at any time during the overlapping sequence and that this requires at least a momentary overlap of actuation of three adjacent plates as the actuation is transferred from plates 1 and 2 to plates 2 and 3 and so on through the sequence.

I claim:

1. In a control system having a multiple switch device of more than two switches arranged to be actuated in sequence and means responsive to actuation of all said switches in sequence, timing means connected to the last named means to have its timing initiated by concurrent actuation of any two of said switches and adapted to have its timing reset quickly responsive to interruption of concurrent actuation of all combinations of any two of said switches, and means operated by said timing means responsive to completion of its timing.

2. In a control system, a multiple switch device having more than two switches and arranged for actuation in an overlapping sequence by units of traffic passing by, means responsive only to actuation of said switches in an overlapping sequence, timing means connected to have its timing initiated by concurrent actuation of any two of said switches and adapted to have its timing reset quickly responsive to interruption of concurrent actuation of all combinations of any two of said switches, and means operated by said timing means responsive to completion of its timing.

3. In a control system having a multiple switch treadle of more than two switches and means operating responsive to closure of said switches in an overlapping sequence, timing means connected to the last named means have its timing initiated by concurrent closure of any two of said switches and adapted to have its timing reset quickly responsive to interruption of concurrent closure of all combinations of any two of said switches, and indicating means operated by said timing means responsive to completion of its timing.

4. In combination, a multiple switch traffic actuatable device of more than two switches, a plurality of relays, operating circuits for said relays controlled by said switches to operate each relay individually by a separate one of said switches, time controlled switch means having an operating circuit and a switch operated responsive to completion of a time period of energization of said operating circuit and connections for said operating circuit including all combinations of pairs of contacts operated by different pairs of said relays for energization of said operating circuit responsive to concurrent operation of any two of said relays.

5. In a control system having a multiple switch device of more than two switches, relays operated individually by said switches, time controlled switch means operating its switch responsive to completion of a timing period of continued actuation and adapted to restart its timing responsive to cessation of actuation, a plurality of actuating circuits for said switch means including pairs of contacts operated by all combinations of said relays taken two at a time to actuate said switch means by concurrent operation of any two of the first mentioned switches for such time period.

6. In a control system having a multiple switch treadle of more than two switches and means operating responsive to closure of said switches in an overlapping sequence, said means including relays operated individually by the respective switches, an additional relay, a plurality of operating circuits for said additional relay including pairs of contacts operated by all different pairs of the first mentioned relays for operation of said additional relay whenever any two of said switches are closed concurrently, and a retarded pickup quick dropout time delay relay operated by operation of said additional relay, and an output circuit controlled by said time delay relay.

7. In a control system having a multiple switch treadle of more than two switches and means operating responsive to closure of said switches

in an overlapping sequence, said means including relays operated individually by the respective switches, retarded pickup quick reset time delay relay means, a plurality of operating circuits for said relay means including pairs of contacts operated by all different pairs of the first mentioned relays, and an output circuit controlled by said time delay relay means by pickup of the latter.

8. In a control system including more than three switches arranged closely side-by-side for operation in a progressive sequence in which more than two adjacent switches are closed concurrently, relays connected to be operated by closure of the respective switches, another relay connected to be operated by concurrent operation of any two of the first mentioned relays, an additional relay connected to be operated by concurrent first operation of the first two of the first mentioned relays, and to be maintained operated by operation of said other relay, a further relay connected to be operated by concurrent operation of said additional relay and of a third and fourth of said first relays together with concurrent release of one of said first two relays, and an output circuit controlled by operation of said further relay and concurrent release of said other relay; time controlled switch means having a delayed action of its switch and connected to be operated by operation of said other relay, and an output device including a circuit controlled by the last mentioned switch to indicate prolonged concurrent operation of two or more of the first mentioned relays which may interfere with proper operation of the first mentioned output circuit by preventing such relay release.

9. In a control system including more than three switches arranged closely side-by-side for operation in a progressive sequence in which more than two adjacent switches are closed concurrently, relays connected to be operated by closure of the respective switches, another relay connected to be operated by concurrent operation of any two of the first mentioned relays, an additional relay connected to be operated by concurrent first operation of the first two of the first mentioned relays, and to be maintained operated by operation of said other relay, a further relay connected to be operated by concurrent operation of said additional relay and of a third and fourth of said first relays together with concurrent release of one of said first two relays, and an output circuit controlled by operation of said further relay and concurrent release of said other relay; a retarded pickup time delay relay connected to be operated by operation of said other relay, and an output device controlled by said time delay relay by pickup of the latter to indicate prolonged concurrent operation of two or more of the first mentioned relays which may interfere with proper operation of the first mentioned output circuit by preventing such relay release.

10. In a control system, a multiple switch treadle adapted to have its switches actuated sequentially by a wheel rolling thereover, time controlled switch means having a switch operated only after a time period of actuation of said means, circuit means operated by concurrent actuation of two of the first mentioned switches to actuate said time controlled switch means and a control circuit controlled by said time controlled switch.

11. In a control system, a multiple switch treadle adapted to have its switches actuated sequentially by a wheel rolling thereover, time controlled switch means having a switch operated only after a time period of actuation of said means, circuit means operated by concurrent actuation of two of the first mentioned switches to actuate said time controlled switch means and an indicating device controlled by said time controlled switch.

12. In a control system, a multiple switch treadle adapted to have its switches actuated in an overlapping sequence by a wheel rolling thereover, time controlled switch means having a switch operated only after a time period of actuation of said means, relays connected to be operated individually by the respective first mentioned switches, contacts operated by the respective relays, and a plurality of operating circuits for said time controlled switch means including pairs of said contacts for all combinations of said relays two at a time to actuate said time controlled switch means throughout concurrent operation of every pair of said relays.

13. In a control system, a multiple switch treadle adapted to have its switches actuated sequentially by a wheel rolling thereover, relays connected to be operated individually by the respective switches, contacts closed by operation of the respective relays, time delay relay means, a plurality of operating circuits for the last said means each including in series a pair of contacts of a different pair of said relays, and an output circuit including a contact operated by said time delay relay means at the end of its time delay.

14. In a control system including a multiple switch treadle adapted to have its switches closed sequentially by a wheel rolling thereover, a plurality of relays having coils connected to be energized individually by closure of the respective switches and each relay having contacts closed by energization of its associated coil, a further relay having a coil and contacts closed and further contacts opened by energization of the latter coil, a plurality of energizing circuits for the last mentioned coil each including in series contacts of a different pair of said plurality of relays, and output means including other contacts of said relays to be operated by deenergization of said further relay after energization of said plurality of relays and deenergization of one of said relays in overlapping sequence; a time delay relay having an operating coil connected to be controlled by the contacts of said further relay and having contacts operated by said operating coil after its time delay, and another output device controlled by the contacts of said time delay relay to indicate any prolonged concurrent energization of a plurality of the first-mentioned relays which may interfere with such operation of the first mentioned output means by preventing such deenergization of relays.

15. In a control system including a multiple switch device having more than two switches and arranged for actuation in an overlapping sequence by units of traffic passing by, relays connected to be operated by operation of the respective switches, another relay connected to be operated by concurrent operation of any two of the first mentioned switches, an additional relay connected to be operated by concurrent first operation of the first two of the first mentioned relays, and to be maintained operated by operation of said other relay, a further relay connected to be operated by concurrent operation of said additional relay and of a third and fourth of said

first relays together with concurrent release of one of said first two relays, and means including a circuit controlled by operation of said further relay and concurrent release of said other relay for normally registering passage of such traffic units, time controlled switch means having a delayed action of its switch and connected to be operated by operation of said other relay, and an alarm device and an operating circuit for said device controlled by the last mentioned switch whereby prolonged operation of two or more of said first mentioned switches will be indicated by said device to warn of possible interference with normal registration of traffic.

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