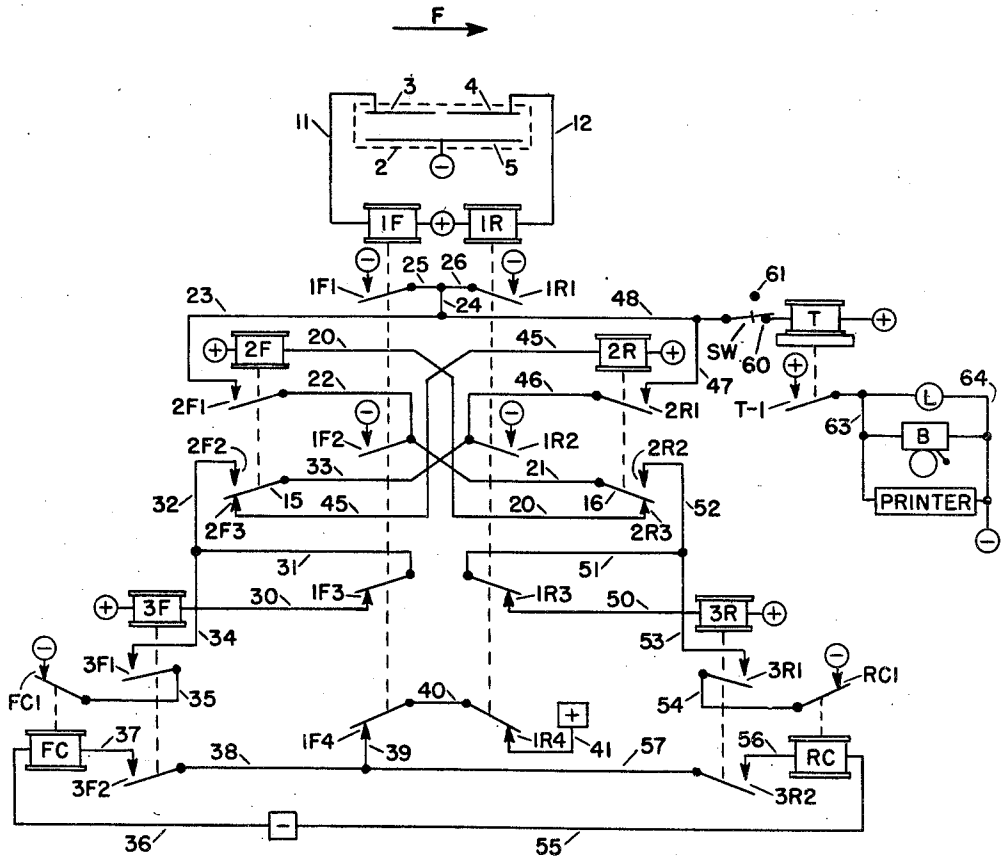
July 15, 1952 J. L. BARKER ET AL 2,603,419

TREADLE CONTROLLED COUNTING SYSTEM

Filed Dec. 8, 1949



INVENTORS
JOHN L. BARKER AND
EDWARD H. EAMES
BY Edward H. Eames
ATTORNEY

Patented July 15, 1952 2,603,419

UNITED STATES PATENT OFFICE

2,603,419

TREADLE CONTROLLED COUNTING SYSTEM

John L. Barker, Norwalk, and Edward H. Eames, East Norwalk, Conn., assignors to Eastern Industries, Incorporated, East Norwalk, Conn., a corporation of Delaware

Application December 8, 1949, Serial No. 131,744

9 Claims. (Cl. 235—99)

1

This invention relates generally to a counting system or control system for operating counting devices or indicating devices and the like. More particularly the invention relates to a bi-directional counting 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 and in accordance with the directional order of actuation of the switches. The invention is concerned particularly with an improved system of this character, employing a two switch treadle.

Systems in accordance with the invention are particularly useful in the counting of road vehicle traffic at toll checking points for example where a multi-contact 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 counting primarily responsive to the rolling wheel of the vehicle to count vehicle axles and to be substantially free of actuation by pedestrians or toll collectors by casual or random momentary closure of one or more of the treadle switches.

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 two axle pleasure vehicles.

It is an object of this invention to provide an improved system for operation of one or another of two counters responsive to actuation and release of the switches of a two switch treadle substantially only in an overlapping sequence and in accordance with the directional order of such sequence.

Another object of the invention is to provide an improved counting system having a forward counter and a reverse counter and a two-stitch treadle and a relay circuit interconnecting the counters with the treadle for actuation of the forward counter responsive to the treadle switches being actuated and released in an overlapping sequence in the forward direction and for actuation of the reverse counter responsive to the actuation and release of the switches in overlapping sequence in the reverse direction.

A further object of the invention is to provide a control system employing a two-switch treadle

2

for actuation of one counter or other electrical device by a wheel rolling over the treadle and operating the switches in an overlapping sequence of actuation and release in the forward direction and another such counter or device by a wheel similarly rolling over the treadle in the reverse direction and in which any rolling back and forth of the wheel before leaving the treadle finally in the same direction will operate the counter for that one direction only once upon so leaving the treadle, and if the wheel rolls forth in either direction and partly across the treadle but without leaving the treadle in the initial direction and then rolls back and off in the opposite direction neither of the counters will be operated, but if the wheel rolls sufficiently far back and forth to cross the treadle entirely and leave the treadle in opposite directions alternately the counters for both directions will be operated, with the counter for the initial direction always operated once more than that for the opposite direction if the wheel finally rolls off the treadle in the initial direction.

Another object of the invention is to provide an improved system employing a two switch treadle and a relay system operated by actuation of the two switches in overlapping sequence in which a forward counter or other electrical device is actuated for the forward direction and a reverse counter or other electrical device is actuated for the reverse direction, and in which such counter or device is actuated only upon release of the last switch in a continuous sequence of actuation in the same direction, comprising the first switch alone; then the first and second switches together, then the last switch alone, then the last switch released.

A number of different types of multiple switch relay and counting circuits for actuation by rolling wheels, either by railway or by automobile traffic for example, are well-known in the prior art and these systems employ various numbers of switches for actuation in overlapping sequence. However the circuits involving more than two switches with which we are familiar are relatively complex and necessarily employ quite narrow contact plates, providing a quite short closure time for any one switch or plate for relatively fast moving automobile traffic for example, and those having only two switches with which we are familiar operate the output circuit for the counter or other electrical device either upon closure of the second switch with the first switch or upon release of the first switch after overlapping closure of the first and second switches, and while the wheel is still on the

second switch for example. The present invention provides an improved circuit which is greatly simplified over the prior art circuits involving more than two switches and which provides improved operation with full protection against rolling forward and backward without the wheel rolling off the treadle and avoiding any count if the wheel rolls first in one direction on the treadle and even as far as the last switch alone and then rolls back off the treadle.

Referring now to the drawing, the main negative and positive supply terminals are shown as plus or minus in the circle.

A two-switch treadle 2 is shown schematically in the cross section in the upper part of the drawing with two upper switch contacts 3 and 4 arranged side by side and adapted to engage a common bottom contact plate 5 individually when actuated by pressure on the top plates, the top plates releasing or separating from the bottom plates when the actuation is released. The two upper contact plates are closely enough spaced so that a rolling wheel will depress both upper plates into contact with the lower common plate together as part of an overlapping sequence of actuation by a rolling wheel traversing the contacts in either direction.

Two separate plates may be used in place of the common lower plate 5 so that both upper and lower plates comprise entirely separate switches if desired.

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

The narrow plates 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 plate even though the tire of the vehicle rides directly over the separation strip.

It will be appreciated that the treadle 2 as shown in the drawing is illustrated schematically without such details of construction described and that the wires extending from the upper and lower switch contacts will actually extend from the ends or the edges or near the ends of these contact plates to avoid interference with actuation of the plates by a rolling wheel.

The schematic cross section view shown illustrates the relatively short dimension of the treadle, along the line of travel of traffic, the long dimension of the treadle extending perpendicular to the cross-section shown across the line of travel of traffic. Several forms of construction of treadle switches for vehicular traffic actuation are already well-known in the art. Reference may be had for example to Patent 1,950,491 of C. D. Geer et al., Patent 1,928,472 of H. A. Wilcox and Patent 2,077,924 of C. D. Geer et al., the latter patent showing a two switch treadle, and the first two patents showing different forms of single switch treadle construction. In one form of two switch treadle in general use the spacer or separate strips supporting the upper plates or contacts are placed under each of the edges of each of the upper plates, as in either of the first two patents referred to instead of under some of the edges as illustrated in the Patent 2,077,924.

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 two 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 3 will first contact with plate 5, then plate 4 will contact with plate 5 while 3 and 5 remain in contact, then plate 4 will contact with plate 5 alone with plate 3 released, and then plate 4 will be released from plate 5 as the wheel rolls off the treadle.

In the case of a wheel rolling over the treadle from right to left (the reverse direction) the upper plates 4 and 3 are brought into contact with plate 5 in an overlapping sequence of 4 alone, then 4 and 3 together, then 3 alone and then released.

Shown below the plates 3, 4 and 5 in the drawing is a group of relays 1F, 2F, 3F and a forward counter or electric device FC on the left, and relays 1R, 2R, 3R and a reverse counter or electric device RC on the right. In general the relays 1F and 1R and the relay group 2F, 3F and FC are operated by traverse of a wheel completely across the treadle in the forward direction, and the relays 1R and 1F and the relay group 2R, 3R and RC are operated by the traverse of a wheel completely across the treadle in the reverse direction, the relays 1F and 1R being both operated in either direction but in opposite overlapping sequence for the two directions.

The common bottom plate 5 is connected to negative power, and the left hand upper plate 3 is connected via wire 11 to the left side of the coil of relay 1F, the other side of this coil being connected to positive power. The right hand upper plate 4 is connected via wire 12 to the right side of the coil of relay 1R, the other side of this coil being connected to positive power.

The whole relay circuit for operation of the counters FC and RC in accordance with the direction of actuation of the treadle switches, is in general symmetrical about a vertical line between the relays 1F and 1R.

The relay 1F has two make contacts 1F1 and 1F2 and two break contacts 1F3 and 1F4. The term "make contact" is employed in its usual sense in the art of a relay contact which is normally open when the relay coil is deenergized and is closed when the relay coil is energized. The term "break contact" is employed in its usual sense of a relay contact which is normally open when the relay coil is deenergized and is closed when the relay coil is energized.

Relay 1R similarly has the two make contacts 1R1 and 1R2 and the two break contacts 1R3 and 1R4 operated by the coil marked 1R.

The relay 2F has a single make contact 2F1 and a combination of a make contact 2F2 and a break contact 2F3 having a common armature 15, all of these contacts being controlled by the coil 2F. The relay 2R similarly has a make contact 2R1 and a combination of a make contact

2R2 and a break contact 2R3, the latter two contacts having a common armature 16, all operated by the coil 2R.

The relay 3F has two make contacts 3F1 and 3F2 controlled by the coil 3F. The relay 3R has two make contacts 3R1 and 3R2 controlled by the coil 3R. The counter or electric device FC has the break contact FC1 which is operated near the end of the stroke upon energization of the coil FC. Where this device is an electromagnetic counter the usual counter arm and pawl (not shown) will also be actuated by the coil FC when the latter is energized, the counter arm being pulled toward the coil FC against a return spring for example, either to directly advance a counter ratchet wheel on the "pull-in" stroke on the energization of the coil FC, or to advance the counter ratchet wheel upon the return stroke on subsequent deenergization of the coil FC release of the pawl. In either case the break contact FC1 is opened only near the end of the pull-in stroke where the advance of the counter wheel is assured. In the preferred form of the invention the counter wheel will be advanced on the return stroke but either form of counter wheel advance may be employed and both are so well-known in the art that it is believed unnecessary to illustrate them.

The device or counter RC is similarly arranged to control the break contact RC1 and to advance a reverse counter wheel for example once upon one cycle of energization and deenergization of the coil RC.

A circuit may be traced for energizing the relay 2F under the control of the make contact 1F2 as follows: from the right side of the coil 2F via wire 20, break contact 2R3 of relay 2R, armature 16, wire 21, and via contact 1F2 of relay 1F to negative power, positive power being directly connected to the left side of the coil of 2F. A holding circuit is provided for this coil, extending via wire 20 from the right side of coil 2F, via break contact 2R3, armature 16, wire 21, wire 22, make contact 2F1 of relay 2F, wire 23, wire 24, wire 25, and the make contact 1F1 to relay 1F. A branch holding circuit for the coil of 2F extends from the wire 24 previously just described to the right via wire 26 and a make contact 1R1 on relay 1R.

An operating circuit for the relay 3F may be traced from the right side of the coil of relay 3F via wire 30, break contact 1F3 of relay 1F, wire 31, wire 32, make contact 2F2 and armature 15 of relay 2F, wire 33 and make contact 1R2 of relay 1R to negative power, the other side of the coil of relay 3F being connected to positive power directly. A holding circuit for the coil of 3F may be traced via wire 30, break contact 1F3 of relay 1F, wire 31, wire 34, make contact 3F1 of relay 3F, wire 35, break contact FC1 of the counter FC to negative power.

The same positive and negative power as employed and shown by plus and minus in a circle for the other relays, may be employed for the counters FC and RC if desired. However it is frequently desirable to employ a different source of positive and negative power of a different voltage or otherwise for operation of the counters and in the preferred form of the invention this is illustrated by showing separate sources of positive and negative powers for the counters as indicated by the plus and minus in a square in the lower part of the drawing.

An operating circuit for the counter FC may be traced from the negative counter power minus in a square, at the lower part of the drawing, and extending to the left via wire 36, through the coil of the counter FC and via wire 37, make contact 3F2 of relay 3F, wire 38, wire 39, break contact 1F4 of relay 1F, wire 40, break contact 1R4 of relay 1R, and wire 41 to positive counter power in the square.

An operating circuit for the relay 1R can be traced from the right side of the coil of relay 1R via wire 12, via contact 4 and 5 when closed in the treadle switch, to negative power, the opposite side of the coil of relay 1R being connected to positive power directly.

An operating circuit for the relay 2R may be traced from the left side of the coil of relay 2R via wire 45, break contact 2F3 and armature 15 of relay 2F, wire 33, and make contact 1R2 of relay 1R to negative power, the other side of the coil of relay 2R being connected directly to positive power.

A holding circuit for the relay 2R can be traced via wire 45, break contact 2F3, armature 15, wire 33, wire 46, make contact 2R1 of relay 2R, wire 47, wire 48, wire 24 and then branching either via wire 25 and make contact 1F1 of relay 1F to negative power or via wire 26 and make contact 1R1 of relay 1R to negative power.

An operating circuit for the coil of relay 3R can be traced from the left side of the coil via wire 50, break contact 1R3 of relay 1R, wire 51, wire 52, make contact 2R2 and armature 16 of relay 2R, wire 21, and make contact 1F2 of relay 1F to negative power, the other side of the coil of relay 3R being connected directly to positive power.

A holding circuit for the coil of relay 3R may be traced via wire 50, break contact 1R3, wire 51, wire 53, make contact 3R1 of relay 3R, wire 54 and break contact RC1 to negative power.

An operating circuit for the coil of the counter RC can be traced beginning at the negative power in the square at the lower part of the drawing and continuing to the right via wire 55, through the coil of the counter RC, wire 56, make contact 3R2 of the relay 3R, wire 57, wire 39, break contact 1F4 of relay 1F, wire 40, break contact 1R4 of relay 1R, and wire 41 to positive power in the square.

It will be noted that both the initial operating circuits and the holding circuits for each of the relays 2F and 2R proceed through a break contact 2R3 or 2F3 on the other of these relays respectively, thus interlocking these relays so that the first actuation of the corresponding first contact 3 or contact 4 and the associated relay 1F or 1R respectively as the wheel first rolls on the treadle in any particular traverse of the treadle, will cause energization of the corresponding one of the relays 2F or 2R respectively and prevent the energization of the other by the following actuation of the second of the contacts 3 or 4 in the initial direction, so that throughout any traverse or rolling back and forth of the wheel on the treadle the proper relay 2F or 2R will remain energized to "remember" the direction in which the wheel initially rolled on to the treadle.

Operation of the system by forward actuation

As a wheel rolls forward from left to right over the treadle it will first depress the upper contact 3 against the lower contact 5, thus completing the operating circuit previously traced for the coil of the relay 1F, which will raise all of the armatures illustrated below this relay coil, and associated by the vertical broken line, and operate its contacts. The consequent closing of

the make contact 1F2 will complete the operating circuit for coil of the relay 2F previously traced via the break contact 2R3, thus energizing relay 2F and raising its associated armatures and operating its contacts. Upon closing of the make contact 2F1 by initial energization of relay 2F as described the holding circuit previously traced for relay 2F will be completed via the break contact 2R3 and via the make contact 1F1 of relay 1F.

Proceeding now with the forward actuation by continued progress of the wheel the upper plate 4 is also depressed to touch contact 5 while upper contact 3 remains depressed to touch contact 5. At this stage an operating circuit is completed as previously traced via contacts 4 and 5 to energize relay 1R thus holding this relay to raise all of its armatures shown below directly below it, thus closing its make contacts and opening its break contacts. The closing of the make contact 1R1 completes a second holding circuit as previously traced for the coil of relay 2F. It will be noted that both the initial operating circuit and the holding circuit for the relay 2F extend through the break contact 2R3 of the relay 2R thus preventing operation of relay 2F, where plate 4 and relay 1R are next actuated as the wheel continues to roll forward, since relay 2R was first operated.

As the wheel continues to roll forward the contact 3 will next be released from the contact 5, thus opening the operating circuit of the coil of relay 1F and deenergizing this relay which causes its armatures to drop, thus opening its make contacts and closing its break contacts. The consequent closing of the break contact 1F3 completes the operating circuit for the coil of the relay 3F as previously traced via this break contact 1F3 and the make contact 2F2 of relay 2F and the make contact of 1R2 of relay 1R, thus energizing relay 3F and causing its make contact 3F1 to close. This in turn completes a holding circuit for the coil of relay 3F via the break contact 1F3 and the make contact 3F1 and the break contact FC1.

As the wheel continues to roll forward and off the treadle so as to release the contact 4 and open the operating circuit for the relay 1R the armatures of this relay drop, thus opening its make contacts and closing its break contacts. The consequent closing of its break contact 1R4 completes the operating circuit for the forward counter FC as previously traced via the break contact 1R4, the break contact 1F4 and the make contact 3F2, thus operating the counter FC and opening its break contact FC1, which in turn releases the relay 3F by interrupting its holding circuit as previously traced. As the wheel rolled off and reopened the treadle contacts 4—5 the last holding circuit for the coil of the relay 2F was also opened at make contact 1R1, which deenergized relay 2F, but the deenergization of this relay does not deenergize the relay 3F since the latter has been maintained energized long enough to operate the counter FC by its holding circuit via the break contact 1F3, the make contact 3F1 and the break contact FC1 as previously described, the operation of the counter itself opening this holding circuit and releasing relay 3F thus restoring the entire system to normal inactive condition as shown in the drawing.

Operation by reverse actuation

If a wheel rolls on the treadle in the reverse direction, from right to left, the sequence of events will be reversed and the initial closing of the contact 4—5 will first operate the relay 1R and consequently immediately operate the relay 2R by the closing of the make contact 1R2 on relay 1R. A holding circuit for the relay 2R will then be closed via the make contact 2R1 of relay 2R and the make contact 1R1 of relay 1R as previously traced.

As the wheel proceeds further in the reverse direction closing contacts 3—5 while contacts 4—5 remain closed, an auxiliary holding circuit for relay 2R will be completed via the make contact 1F1 of relay 1F which will have been operated by closure of contact 3—5. As the wheel rolls further in the reverse direction releasing contact 4 and thus deenergizing the relay 1R the relay 3R will then be operated by completion of its operating circuit via the break contact 1R3. The relay 3R will be maintained operated by its holding circuit via its make contact 3R1 and the break contact RC1 on the counter RC. As the wheel continues to roll in the reverse direction and off the treadle releasing the contact 3, the opening of the contact 3—5 will deenergize the relay 1F and consequently complete an operating circuit for the counter RC via the break contacts 1R4, 1F4 and the make contact 3R2. The operation of the counter RC will in turn open its break contact RC1 momentarily to interrupt the holding circuit of relay 3R and thus release this relay. The relay 2R will have been released by this time by the interruption of its last holding circuit via the make contact 1F1 and the circuit will be restored to normal inactive condition.

Forward and roll-back operation

If a wheel rolls on the treadle initially in a forward direction, thus closing initially the contacts 3—5 and then rolls forward far enough to close contacts 4—5 and then release contacts 3—5 while contacts 4—5 remain closed, without entirely rolling off the treadle, and then rolls back again to reclose contact 3—5 and reopen contacts 4—5 and then release contacts 3—5 by rolling off the treadle to the left, opposite to the initial direction, the relays 1F, 2F and 1R will be operated in that order, and the relay 1F will be released and the relay 3F will consequently be energized upon arrival of the wheel at the farthest point of advance with contact 4—5 closed alone, and the subsequent rolling back of the wheel to reclose contact 3—5 will reenergize relay 1F and consequently release relay 3F by interrupting its operating and holding circuits at the break contact 1F3. Thus as the wheel finally rolls off to the left opposite to its initial forward direction, at the end of such roll-back operation, the remaining relays 1F and 2F will be released to their original inactive condition and no operation of the counter FC will have been obtained since the FC circuit will have been open at contact 3F2. The relays 2R and 3R will have been prevented from operation and consequently prevent counter RC from operation, since the initial operation of relay 2F by the initial actuation of switch 3—5 will block the operation of relay 2R by the opening of the break contact 2F3 and holding open of this contact while the wheel is rolling back and forth on the treadle.

The wheel may roll back and forth from the operation of contacts 3—5 alone through the overlap of both to the operation of the contacts

4—5 alone repeatedly without operation of either of the counters unless the wheel finally proceeds off the treadle in the initial direction and releases the final contact in this direction.

During such rolling back and forth the relays 1F and 1R are operated and either the relays 2F and 3F are operated if the initial actuation is in the forward direction or the relays 2R and 3R are operated if the initial actuation is in the reverse direction but in neither case are either of the counters FC or RC operated unless the wheel completes its traverse off the treadle in the initial direction in which case the proper counter FC or RC is operated depending upon the completion of traverse in the same forward or reverse direction respectively as the initiation of the traverse.

As previously pointed out if the wheel rolls back off the treadle opposite to the initial direction neither of the counters will be operated and the system will be restored to normal inactive condition despite any amount of rolling back and forth while the wheel is still in continuous contact with the treadle. This condition also applies if the wheel makes its initial traverse onto the treadle in the reverse direction, then rolls back and forth and then finally rolls off the treadle to the right in the opposite to its initial direction.

Under these latter conditions the relays 1R and 2R will be initially operated, then the relay 1F will be operated, then the relay 3R will be operated when the relay 1R is released at the farthest point of advance of the wheel in the reverse direction with contacts 3—5 alone closed, the relay 3R being released again by the reopening of the break contact 1R3 as the wheel rolls back to reclose the contacts 4—5 to reoperate relay 1R, and the relays 1R and 2R being released as the wheel leaves the treadle to the right opposite to its initial direction.

Excessive actuation time indicator

Some times it is desirable to have an alarm or other indication of the continued closure or actuation of the switches of the treadle longer than a predetermined short time period which would be considerably longer than the normal actuation time occurring by the usual rolling of the wheel over the treadle by an automobile proceeding over the treadle for example. This is particularly desirable under some circumstances to indicate whether there is any continued closure of one of the two treadle switches such as would interfere with the counting operation by a wheel rolling over the treadle. If this feature is desired it may be provided by the closing of the switch SW as shown, connected at the junction of the wires 47 and 48 to complete the circuit to the left side of the operating coil of a time delay relay T, the other side of its coil being connected directly to positive power. This is a slow pull-in and quick release type time relay and its energization closes its make contact T-1 after a brief time delay of a few seconds for example, to apply positive power for operation of the lamp L, the bell B and the printer indicated in the right side of the drawing the opposite sides of these last three devices being connected directly to negative power. The printer may be of the time stamp type for example that makes a record of the date and time of day that the overtime actuation of the treadle switch occurred. It is obvious that any or all of these alarm and recording devices may be used if desired, or they may be omitted or disconnected from use if desired as by moving the switch SW from closed contact 60 to open contact position 61 for example.

It will be appreciated by those skilled in the art that rearrangements or substitutions may be made in the various parts of the system without departing from the spirit of the invention.

We claim:

1. A counting system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence, two counters, operating circuits for the respective counters, and relay means controlled by said two switches for controlling said operating circuits, said relay means including means for preparing for subsequent completion by release of the last actuated of said switches the operating circuit for one counter only in response to actuation of said two switches in a predetermined order in overlapping sequence of one switch alone followed by the other switch with the first switch followed by release of the first switch, means for preparing for subsequent completion by release of the last actuated of said switches in the opposite order the operating switch for the other counter only in response to actuation of said two switches and release of the first actuated switch in such overlapping sequence in the opposite order, means for completing whichever operating circuit is so prepared for operating its associated counter in response to release of the last actuated switch while the first actuated switch remains released, and means for releasing said operating circuit preparing means to restore either prepared operating circuit to unprepared condition in response to reactuation of the first actuated switch before release of the last actuated switch and to maintain said preparing means released to maintain such unprepared condition during any subsequent release of the first actuated switch before any reactuation of the last actuated switch, whereby the actuation of said two switches and the release of only the first actuated switch in one order followed by the reactuation of the first actuated switch and the release of said switches in the opposite order will not operate the counter but an overlapping sequence of actuation and release of both switches in the same continuing order will operate the proper counter.

2. A counting system including in combination, a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence, a forward counter, a reverse counter, and a three stage relay circuit controlled by said two switches for operation of the forward counter only in response to completion of an overlapping sequence of actuation and release of said two switches in one direction and for operation of the reverse counter only in response to completion of an overlapping sequence of actuation and release of said two switches in the opposite direction; said relay circuit including for each of the two directions a first stage means for initial operation in response to initial actuation of a different one alone of said two switches and for continued operation thereafter in response to continued actuation of either of said switches, a second stage means for initial operation in response to release of the first actuated switch while said first stage means is operated and for continued operation thereafter in response to continued release of said first actuated switch until the counter for its associated direction is operated, a third stage means for operation of said

counter for its associated direction in response to release of said second actuated switch while said second stage means is operated.

3. A counting system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence, a counter, an operating circuit for said counter, and relay means controlled by said two switches for controlling said operating circuit for operating said counter only by completion of three stages of preparation, said relay means including means operated by initial actuation of a first of said switches alone for completion of the first preparatory stage, and holding means for maintaining said last named means operated throughout an overlapping sequence of actuation of said first switch and the second switch and release of said first switch, means operated by release of said first switch while said first preparatory stage is so completed for completion of said second preparatory stage, holding means for maintaining said second preparatory stage means operated in response to continued release of said first switch and until said counter is operated, and means operated by release of said second switch while said second preparatory stage is so completed to complete the third stage to operate said counter.

4. A relay system including first, second and third forward relays and first, second and third reverse relays, a multiple switch treadle having two switches closely spaced side by side and actuatable in overlapping sequence in a forward or reverse direction, an operating circuit for the first forward relay including the first of said two switches in the forward direction for operation by actuation thereof, an operating circuit for the first reverse relay including the other of said two switches comprising the first switch in the reverse direction for operation by actuation thereof, an operating circuit for the second forward relay including a make contact on the first forward relay and a break contact on the second reverse relay for operation of the second forward relay, an operating circuit for the second reverse relay including a make contact on the first reverse relay and a break contact on the second forward relay for operation of the second reverse relay, holding circuits for the respective second forward and second reverse relays including a make contact on one of these respective relays and a break contact on the other of these respective relays and make contacts in parallel on the first forward and first reverse relays, an operating circuit for the third forward relay including a break contact on the first forward relay and a make contact on the second forward relay and a make contact on the first reverse relay, an operating circuit for the third reverse relay including a break contact on the first reverse relay and a make contact on the second reverse relay and a make contact on the first forward relay, a forward output relay and a reverse output relay, a holding circuit for the third forward relay including a break contact on the first forward relay and a make contact on the third forward relay and a break contact on the forward output relay, a holding circuit for the third reverse relay including a break contact on the first reverse relay and a make contact on the third reverse relay and a break contact on the reverse output relay, an operating circuit for the forward output relay including break contacts on the first forward and first reverse relays and a make contact on the third forward relay, and an operating circuit for the reverse output relay including a make contact on the third reverse relay and break contacts on the first forward and first reverse relays.

5. In a relay system for operating counters in accordance with the order of actuation of two switches in overlapping sequence, two groups of relays having corresponding sets of contacts and operating and holding circuits, one group for operation by initial actuation of the first of said two switches in the forward direction and the other group for operation by initial actuation of the second of two switches as the first in the reverse direction, the forward group concluding a first forward relay, a second forward relay and a third forward relay, and the reverse group including a first reverse relay, a second reverse relay and a third reverse relay, an operating circuit for the first relay of each group including the first switch in its associated direction, an operating circuit for the second relay in each group including a break contact on the corresponding relay of the opposite group and a make contact on the first relay of its own group, a holding circuit for the second relay of each group including a make contact on said second relay, a break contact on the second relay of the opposite group and make contacts in parallel on the first relay of each group, an operating circuit for the third relay of each group including a break contact on the first relay of its group and a make contact on the second relay of its group and a make contact on the first relay of the opposite group, a holding circuit for the third relay of each group including the make contact on such relay and a break contact on the first relay of its group and a break contact on the counter for the direction corresponding to that group for release of said holding circuit by opening of said contact on said counter upon substantially full stroke of said counter and an operating circuit for the counter corresponding to each group including break contacts on the first relays of both groups and a make contact on the third relay of its associated group.

6. A control system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence as by a rolling wheel, two counters, relay means connected between said switches and said counters to operate one such counter only in response to actuation of said two switches in an overlapping sequence of operation and release in one direction and to operate the other such counter only in response to actuation of said two switches in an overlapping sequence of operation and release in the opposite direction, said relay means including a relay individual to each of said switches for operation thereby, an initial direction relay for each direction for initial operation only by the first of said switches in a given direction and having a self-holding circuit for holding such initial direction relay operated while either of said switches is actuated after initial operation of such initial direction relay, a counting preparatory relay for each direction for initial operation only by release of the first switch in such direction after actuation of the first and second switches in that direction and while the second switch remains actuated and having a self-holding circuit for maintaining such counting preparatory relay operated after initial operation so long as the first switch in the corresponding initial direction remains released and until the corresponding counter is operated, and operating circuits for the respective counters in-

cluding contacts controlled by the respective preparatory relays and contacts controlled by the relays individual to said switches for completion of the operating circuit for the appropriate counter in response to release of the last of said individual relays while said counting preparatory relay is operated.

7. A counting system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence as by a rolling wheel, a forward counter, a reverse counter, and relay means connected between the said switches and said counter to actuate said forward counter only in response to operation of said two switches in an overlapping sequence of actuation and release in a forward direction and to operate said reverse counter only in response to operation of said two switches in an overlapping sequence of actuation and release in a reverse direction, said relay means including relays operated individually by the respective switches, a forward relay and a reverse relay, and interlocked operating circuits for the said forward and reverse relays for operating said forward relay and preventing operation of said reverse relay by initial actuation of the first of said two switches in one direction as by a wheel rolling in said one direction and for operating the said reverse relay and preventing operation of said forward relay by initial actuation of the other of said two switches first as by a wheel rolling in the opposite direction, further relays for the forward and reverse directions connected to be operated respectively in response to release of the first actuated of said two switches following actuation of the second with the first of said switches in the respective directions while one of said forward and reverse relays is operated respectively, and circuits for the operation of either of the respective counters and including contacts controlled by the respective further relays and contacts controlled by the first named relays for preparation of the respective circuits by operation of the respective further relays and for completion of one of said circuits respectively by release of both of the first named relays individual to the two switches when so prepared.

8. A counting system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence as by a rolling wheel, a forward counter, a reverse counter, and relay means connected between said switches and said counters to actuate the forward counter only in response to operation of said two switches in an overlapping sequence of actuation and release in a forward direction and to operate said reverse counter only in response to operation of said two switches in an overlapping sequence of actuation and release in a reverse direction, said relay means including a first relay operated by the first of said treadle switches, a second relay operated by the second of said treadle switches, a second forward relay operated by said first relay initially in absence of operation of said second relay, a second reverse relay for operation by initial operation of said second relay in absence of operation of said first relay, holding circuits for the respective second forward and second reverse relays to maintain operated whichever of these relays is first operated so long as either of the first and second relays remains thereafter operated, a third forward relay for operation by release of said first relay after initial operation of said second forward relay and while said second forward relay remains operated, a third reverse relay for operation by release of said second relay after initial operation of said reverse relay and while said second reverse relay remains operated, holding circuits for the respective third forward and third reverse relays controlled by the respective forward and reverse counters to release whichever of the latter two relays is operated upon operation of its associated counter, operating circuits for the respective forward and reverse counters connected to be completed only by release of both of the first and second relays while one or the other of the respective third forward and third reverse relays remains operated.

9. A control system including in combination a multiple switch treadle having two switches arranged closely side by side for actuation in overlapping sequence as by a rolling wheel, two electrical devices, relay means connected between said switches and said electrical devices to operate one such device only in response to actuation of said two switches in an overlapping sequence of operation and release in one direction and to operate the other such device only in response to actuation of said two switches in an overlapping sequence of operation and release in the opposite direction, said relay means including a relay individual to each of said switches for operation thereby, an initial direction relay for each direction for initial operation only by the first of said switches in a given direction and having a self-holding circuit for holding such initial direction relay operated while either of said switches is actuated after initial operation of such initial direction relay, a preparatory relay for each direction for initial operation only by release of the first switch in such direction after actuation of the first and second switches in that direction and while the second switch remains actuated and having a self-holding circuit for maintaining such preparatory relay operated after initial operation so long as the first switch in the corresponding initial direction remains released and until the corresponding device is operated, and operating circuits for the respective electrical devices including contacts controlled by the respective preparatory relays and contacts controlled by the relays individual to said switches for completion of the operating circuit for the appropriate device in response to release of the last of said individual relays while said preparatory relay is operated.

JOHN L. BARKER.
EDWARD H. EAMES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,186,922	Hampton et al.	Jan. 9, 1940
2,205,555	Cooper	June 25, 1940
2,268,925	Cooper	Jan. 6, 1942
2,311,359	Barker	Feb. 16, 1943
2,313,627	Cooper	Mar. 9, 1943