Jan. 10, 1956 B. D. BEAMISH 2,730,301

ELECTRIC CAN COUNTER CIRCUIT

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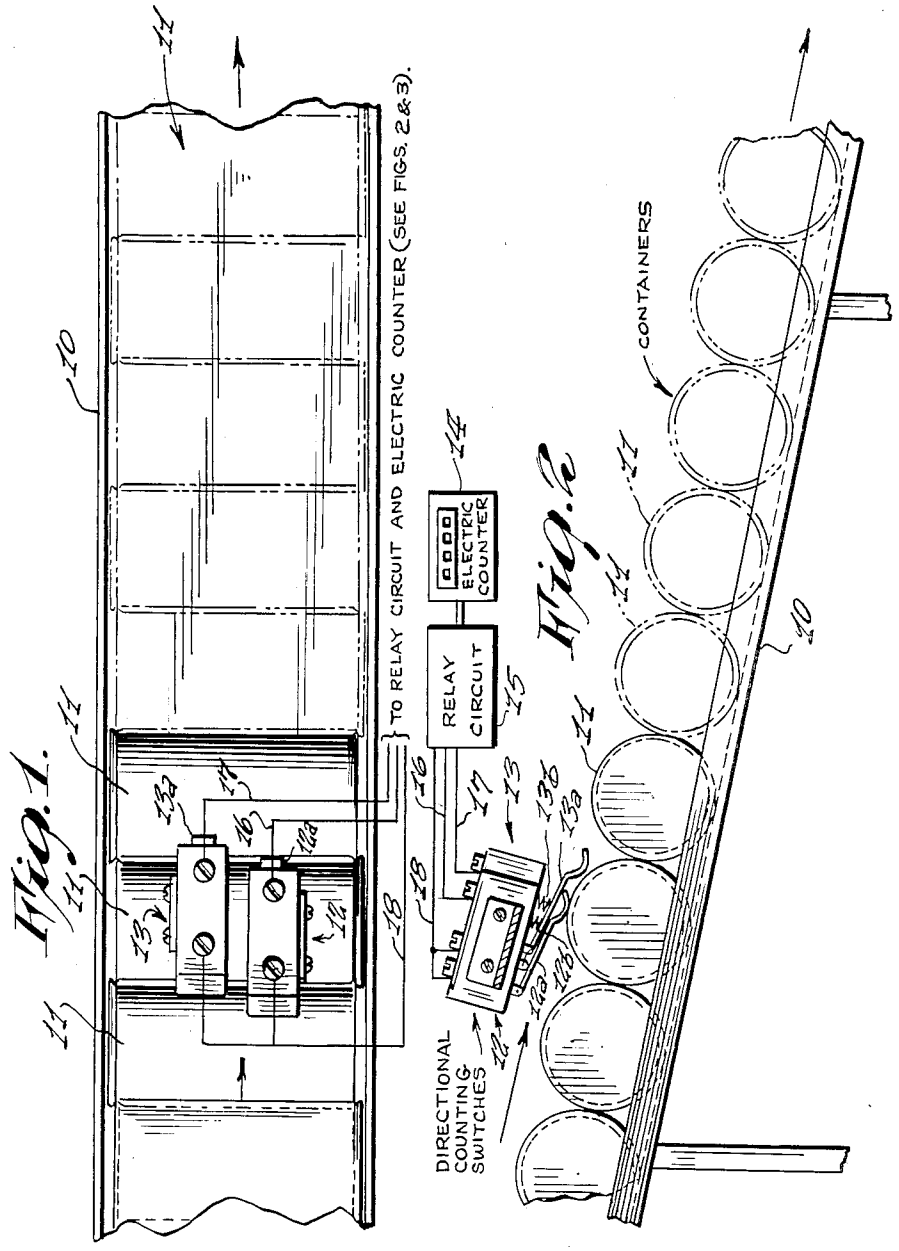



Fig. 1.

Fig. 2

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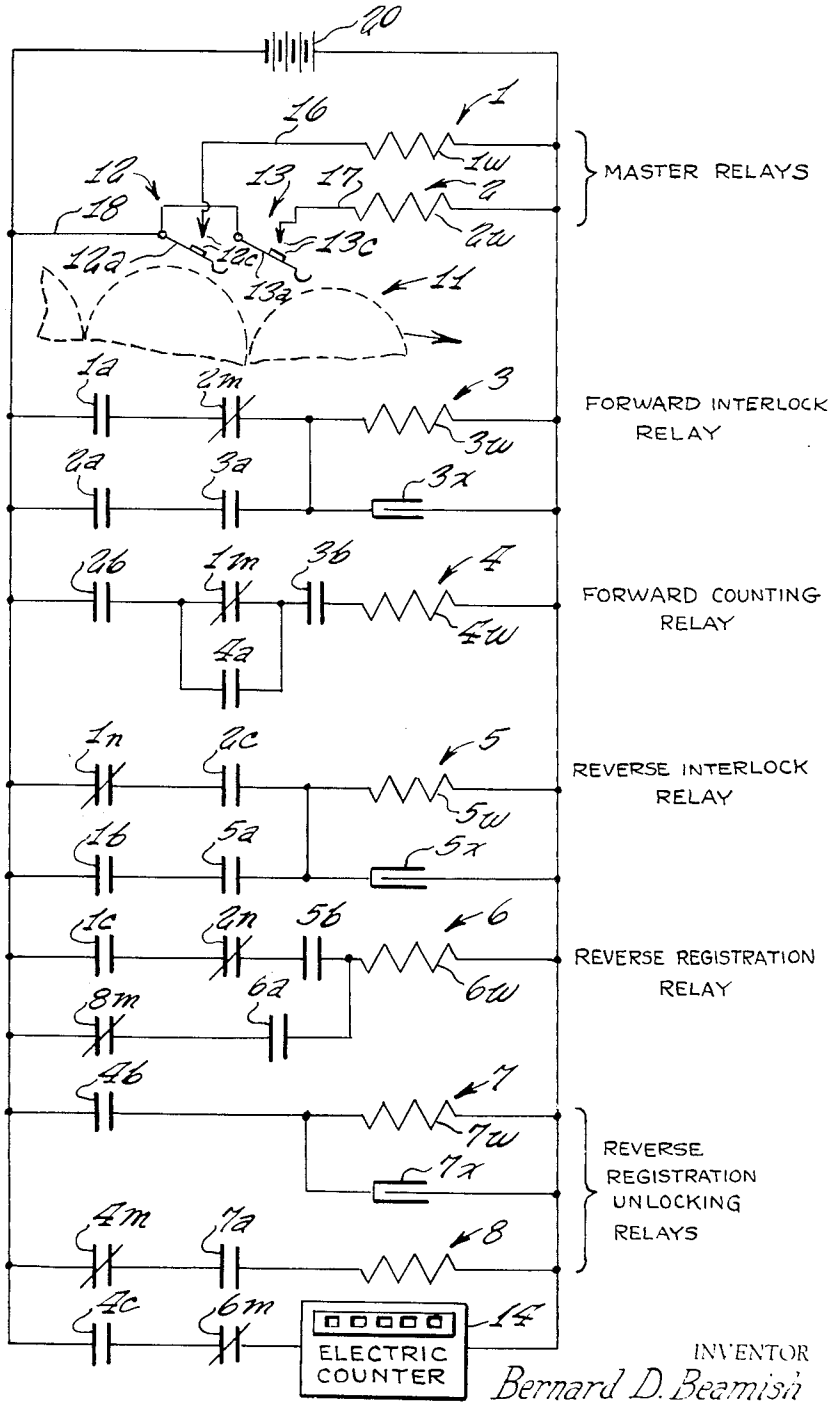
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Fig. 3




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# ELECTRIC CAN COUNTER CIRCUIT

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11 Claims. (Cl. 235—98)

The present invention relates to unidirectionally responsive electrically controlled counting devices, and more particularly to a relay chain which will receive and transmit counting impulses from a directionally responsive object sensing means.

Among the objects of the invention is the provision of an error elimination device for interposition between object sensing means and a counting device which will prevent an erroneous count if a normal forwardly moving succession of objects to be counted should stop, reverse its direction of movement to a limited extent, and then resume its normal forward direction of movement.

A further object of the invention is to provide an error elimination device of this character which comprises a relay chain which is controlled by directionally responsive object sensing means, the relay chain being capable of storing at least one full count in the reverse direction and being so arranged that such a stored reverse count must first be cancelled by a complete forward count before a further counting impulse will be transmitted to the counting device.

In the embodiment of the invention herein shown and described, the invention is illustratively applied to the counting of cylindrical objects exemplified by empty tin cans rolling down a chute.

Tin cans are customarily conveyed from the production lines on horizontal cable conveyors. The cans stand vertically on moving steel cables supported on each side by strap iron guides. These conveyors run along the ceiling adjacent to and parallel to one or more rows of box cars into which the cans are to be loaded. At intervals, on a long conveyor, brush-off gates are provided so as to sweep the cans off the conveyor at a point opposite the door of a particular car to be loaded. The empty cans then pass through a twist chute at the bottom of which they are positioned horizontally with their long axes parallel to the conveyor; in other words, they are so arranged as to roll down an incline set at right angles to the conveyor and leading into the door of the box car. This incline is ordinarily pitched in practice at about 12 degrees.

The loading of the cans into the box cars is intermittent and at times the entire loading chute from its discharge extremity within the box car and extending all the way back to the conveyor becomes totally loaded with cans so that the cans still remaining on the conveyor remain stationary and slip over the running cable. Thus, suddenly a forkfull, usually 16 cans, are simultaneously lifted from the chute inside the box car, and all the cans in the entire chute thereupon surge forwardly under the acceleration of gravity, thus clearing the brush-off gate of the conveyor and the upper portion of the chute including the twist portion thereof. These cans attain a considerable velocity during the forward surge, and when they strike the extreme lower end of the chute they bounce and reverse their direction of movement along the chute in a shock wave which may reach as far back as the conveyor. This intermittent flow of cans is the normal procedure, so that the flow rate of cans passing any given point along the chute is extremely variable. Empty cans have very little rolling friction on the incline, but they are relatively compressible with a great deal of inherent springiness and they have very little mass and consequently very little inertia. All of these factors combine to produce a highly erratic condition of flow.



The conveyors ordinarily run at approximately 500 cans per minute which, in the case of a can with a diameter of 2 inches for instance, is a rate of 1.4 ft. per second with adjacent cans in contact with each other. When flowing freely the cans accelerate down the incline and tend to spread out. In this condition their repetition rate in passing a given point remains the same as the flow rate of the conveyor, i. e., 500 cans per minute. However, when cans rolling down the incline are dammed up and the dam suddenly breaks, all the cans on the incline accelerate simultaneously and shortly reach speeds in the order of 4 to 5 ft. per second. Since they accelerate evenly and they are closely spaced, their frequency for counting purpose becomes a function of the speed and in a matter of a few feet exceeds 2000 cans per minute.

Without resorting to electronic counters, various electro mechanical counting relay systems are known which will operate at a counting rate of one thousand impulses per minute or faster and the tens digit of such count can be transferred to a standard commercial electric counter which is an entirely satisfactory device at up to 200 counts per minute. A location for the object sensing perceptive element can be found near the top of the chute such that the frequency will in no case exceed 1500 cans per minute. This, however, does not take into account the situation where the cans suddenly reverse their direction of flow and this tendency to reverse, which may involve movement in the reverse direction to the extent of almost to the full diameter of one can, occurs frequently and may occur with the can in any position whatever with respect to the object sensing device. This particular problem has so far defeated attempts to obtain an accurate count using photoelectric cells or other electronic object sensing or perceptive devices because any can passing forward, then backward, then forward past the precise point of object sensing will be counted three times. It is therefore necessary to have a counting device capable of speeds of action up to 1500 per minute or better which responds only to being actuated in one direction but which, if actuated in the reverse direction, will record or store such a reverse count and apply it against the next forward count for cancellation purposes so that once a can has been counted in the forward direction, no matter how often it oscillates past the object sensing device, it will never be counted again.

The practical importance of such a device arises from the fact that cans are customarily sold by the thousand but are shipped in bulk by the carload in box cars. The internal dimensions of different box cars vary considerably so that the carload physical count as established by the seller and verified by the buyer becomes the unit of measure in trade. The present counting systems used for this purpose are mechanical, depending on the flow of cans, which is somewhat controlled by an arrangement of belting, to turn star wheels which are connected to mechanical counters. In practice these star wheels, having a certain forward inertia, generally over-count by some indeterminate number, and the commercial records are therefore constantly subject to error and dispute. There is obviously, therefore, an important advantage to be derived from the use of a device in accordance with the present invention which is accurate under all conditions and this accuracy is enhanced if the device has no important mechanical parts to impede the flow of the cans and is readily portable for installation on any chute.

Other and further objects and advantages of the invention will become apparent upon reading the following

specification together with the accompanying drawing forming a part thereof.

Referring to the drawing:

Figure 1 is a diagrammatic plan view showing a flow of empty cans along an inclined chute past object sensing means by which counting of the cans is controlled.

Figure 2 is a side view in elevation of the diagrammatic showing of Fig. 1.

Figure 3 is an elementary circuit diagram showing a relay circuit comprising relays **1** to **8** which are adapted for use with the object sensing means and counter of Figs. 1 and 2 for eliminating errors in count which would otherwise be caused by limited movement in the reverse direction of the flow of cans past the object sensing means.

Referring to Figs. 1 and 2, there is shown an inclined chute **10** upon which a series of cans **11** is arranged for downward movement. Constructional details of the chute **10** have been omitted for simplicity of illustration. A fragment of a row of empty cans **11** is shown disposed on chute **10**.

Disposed above the chute **10** is a directionally selective object sensing device illustratively shown as comprising two staggered enclosed single pole normally open switches one generally designated as **12** and the other as **13**. The switches **12** and **13** are arranged to be successively actuated and deactuated by each can of the row **11** as the can passes down the chute **10** and under switches **12—13**. Each of the switches **12** and **13** is provided with a spring biased actuating lever **12***a* and **13***a*, respectively, having a rounded free end adapted to be raised by a can passing thereunder. After the can has passed, the actuating levers **12***a* and **13***a* will individually move downwardly under the influence of the biasing springs **12***b* and **13***b* and be raised again by the next can **11**. The raising of actuating lever **12***a* closes the normally open contacts **12***c* (Fig. 3) of switch **12** and lowering of the actuating lever **12***a* causes the contacts **12***c* of switch **12** to open. Switch **13** is similarly provided with normally open contacts **13***c* controlled by the actuating lever **13***a*.

It is to be understood that the switches **12** and **13** are shown only by way of illustration. Other known forms of object sensing means may be used provided that a forwardly moving object first closes a first contact, secondly closes a second contact while the first contact is held closed, thirdly opens the first contact while the second contact is held closed, and fourthly opens the second contact so that both contacts are again open. Devices of this character comprise photoelectric means, capacity or inductance controlled apparatus, and if the objects to be counted are magnetizable, then electromagnetic means may be utilized. It is essential, however, that the sequence of contact operation in the reverse direction be the opposite of that for the forward direction. Thus, an object moving in the reverse direction will first close the second contact, secondly close the first contact with the second contact held closed, thirdly open the second contact with the first contact held closed, and fourthly open the first contact so that both contacts are again open. This sequence must also prevail for partial movements in either direction, such that the full cycle of contact actuation is incomplete.

Operatively associated with the switches **12—13** is an electric counter **14** which is controlled by the switches **12—13** through an error preventing relay circuit diagrammatically represented in Fig. 2 by the rectangle **15** and comprising eight relays **1** to **8**, as shown in greater detail in Fig. 3. The switch **12** is individually connected to relay circuit **15** by a conductor **16** and the other switch **13** is individually connected to the relay circuit **15** by a conductor **17**. Both of the switches **12—13** are further connected to the relay circuit **15** by a common conductor **18**.

It will be appreciated that the counter **14** may employ various expedients for increasing its counting rate, such as binary electronic counters, relay chains and the like.

Referring to Fig. 3, the switches **12** and **13** are so



arranged that there are four switch conditions which are used for the normal counting of a forwardly moving individual can, and these switch conditions which are successively produced may be listed in order as follows:

| Switch Condition | Switch 12 | Switch 13 |
|---|---|---|
| A—normal | open | open. |
| B—forward approach | closed | open. |
| C—overlap | closed | closed. |
| D—reverse approach | open | closed. |
| A—normal | open | open. |

In the elementary circuit diagram of Fig. 3 the relay circuit **15** is shown comprising eight relays designated generally as **1** to **8** which control the electric counter **14** from switches **12—13**. Each of the relays **1** to **8** is provided with an operating winding **1***w* to **8***w*, respectively.

Relay **1** is a master relay and is a five pole relay comprising three pairs of normally open contacts **1***a*, **1***b* and **1***c* and two pairs of normally closed contacts **1***m* and **1***n*.

Relay **2** is another master relay and is a five pole relay comprising three pairs of normally open contacts **2***a*, **2***b* and **2***c* and two pairs of normally closed contacts **2***m* and **2***n*.

Relay **3** is a forward interlock relay and is a two pole relay comprising two pairs of normally open contacts **3***a* and **3***b*.

Relay **4** is a forward counting relay and is a four pole relay comprising three pairs of normally open contacts **4***a*, **4***b* and **4***c* and a single pair of normally closed contacts **4***m*.

Relay **5** is a reverse interlock relay and is a two pole relay comprising two pairs of normally open contacts **5***a* and **5***b*.

Relay **6** is a reverse registration relay and is a two pole relay comprising one pair of normally open contacts **6***a* and one pair of normally closed contacts **6***m*.

Relay **7** is a reverse registration unlocking relay and is a single pole relay provided with a single pair of normally open contacts **7***a*.

Relay **8** is a further reverse registration unlocking relay and is a single pole relay provided with a single pair of normally closed contacts **8***m*.

A suitable source of current illustratively shown as a battery **20** is provided for the energization of relays **1** to **8** and counter **14**. When the winding **1***w* to **8***w* of any of the relays **1** to **8** is energized, the particular relay operates and closes all of its normally open contacts and opens all of its normally closed contacts.

## NORMAL FORWARD COUNT

### *Condition A.—Normal*

No relays are operated.

### *Condition B.—Forward approach*

When a can is to be counted, it first lifts switch actuating lever **12***a* of switch **12**, causing contacts **12***c* to close. Master relay winding **1***w* is energized and master relay **1** operates closing normally open contacts **1***a*, **1***b* and **1***c* and opening normally closed contacts **1***m* and **1***n*. Master relay **1** remains operated as long as switch **12** is actuated and releases when switch **12** is deactuated.

Closure of contacts **1***a* energizes the winding **3***w* of forward interlock relay **3** through the normally closed contacts **2***m* of master relay **2**. Contacts **2***m* are closed at this time because the can has not yet actuated switch **13** to energize master relay winding **2***w*.

Closure of contacts **1***b* prepared an energizing circuit for reverse interlock relay **5** through its locking contacts **5***a*.

Closure of contacts **1***c* prepares an energizing circuit for reverse registration relay **6** through the closed contacts **2***n* of master relay **2** and the open contacts **5***b* of reverse interlock relay **5**.

Opening of contacts **1***m* prevents forward counting relay **4** from operating by subsequent closure of contacts

2b and 3b. If relay 4 has been previously operated, and is locked in through its own contacts 4a, then the opening or closure of contacts 1m will have no effect.

Opening of contacts 1n prevents reverse interlock relay 5 from operating when contacts 2c close.

The operation of forward interlock relay 3, which accompanied the closure of contacts 1a of master relay 1 caused it to close its normally open contacts 3a and 3b.

Closure of contacts 3a prepares a locking circuit for forward interlock relay 3 under control of contacts 2a of master relay 2. Contacts 2a, however, have not yet closed.

Closure of contacts 3b is ineffective with respect to forward counting relay 4, because contacts 1m of master relay 1 are open, and further, because the contacts 2b of master relay 2 have not yet closed.

*Condition C.—Overlap*

With master relay 1 still operated, the next action of the forwardly moving container is to close contacts 13c by raising arm 13a of switch 13. This operates master relay 2 causing it to close its normally open contacts 2a, 2b and 2c and to open its normally closed contacts 2m and 2n. Contacts 1a, 1b, 1c, 3a and 3b are closed at this time and contacts 1m and 1n are open, as described above.

Closure of contacts 2a completes a locking circuit for forward interlock relay 3.

Closure of contacts 2b is ineffective, because contacts 1m are open.

Closure of contacts 2c is ineffective, because contacts 1n are open.

Opening of contacts 2m is prevented from releasing forward interlock relay 3 because relay 3 is rendered slow in releasing by the delay capacitor 3x which is connected in multiple with its operating winding 3w. Relay 3 may be rendered slow releasing by other means such as the provision of a copper slug forming a short-circuited turn around a portion of its magnetic circuit or by any other desired conventional means. Alternatively, contacts 2m may be adjusted to remain closed until after contacts 2a have closed to provide a make-before-break sequence between these two pairs of contacts.

Thus, operation of master relay 2 with master relay 1 operated merely transfers control of forward interlock relay 3 from master relay 1 to master relay 2, without other effect.

*Condition D.—Reverse approach, starting from forward approach*

With forward interlock relay 3 operated and master relay 2 operated, master relay 1 releases, as the forwardly progressing can allows switch arm 12 to be pressed downwardly by spring 12b and open contacts 12c.

Contacts 1a, 1b and 1c open and contacts 1m and 1n close.

Opening of contacts 1a is ineffective because contacts 2m are already open.

Opening of contacts 1b opens a locking circuit for reverse interlock relay 5 whose contacts 5a are about to close.

Opening of contacts 1c is ineffective with respect to reverse registration relay 6, because contacts 2n and 5b are open.

Closure of contacts 1m as master relay 1 releases, operates forward counting relay 4 through the presently closed contacts 2b of master relay 2 and contacts 3b of forward interlock relay 3.

Closure of contacts 1n operates reverse interlock relay 5 through closed contacts 2c. Reverse interlock 5 cannot lock in, however, because the locking circuit through its own contacts 5a is broken by the opening of contacts 1b.

When forward counting relay 4 was operated, it closed its normally open contacts 4a, 4b and 4c and opened its normally closed contacts 4m.

Closure of contacts 4a completed a locking circuit for counting relay 4 independently of contacts 1m. At this time, successive openings and closings of contacts 1m of master relay 1 can have no effect on counting relay 4 because contacts 1m are short-circuited by locking contacts 4a of relay 4.

Closure of contacts 4b operates relay 7, causing it to close contacts 7a. Relay 7 is rendered slow in releasing by delay capacitor 7x connected across its operating winding 7w.

Closure of contacts 4c operates electric counter 14 through the presently closed contacts of reverse registration relay 6.

Opening of contacts 4m is sufficiently fast to prevent closure of contacts 7a from causing operation of reverse registration reset relay 8 at this time.

*Condition A.—Normal.—Starting from forward approach*

The can being counted next passes beyond switch 13 after having passed switch 12. This deactuates switch 13, opening contacts 13c and releasing master relay 2, master relay 1 already being released.

Contacts 2a, 2b and 2c open and contacts 2m and 2n close.

Opening of contacts 2a releases forward interlock relay 3, contacts 1a being open.

Opening of contacts 2b releases forward counting relay 4.

Opening of contacts 2c releases reverse interlock relay 5.

Closure of contacts 2m prepares forward interlock relay 3 for operation at the next closure of master relay contacts 1a.

Closure of contacts 1n is ineffective, because contacts 2c are open, this condition of contacts 5b being immaterial.

Release of forward counting relay 4 by opening of contacts 2b causes it to open contacts 4a, 4b and 4c and close contacts 4m.

Opening of locking contacts 4a is ineffective because contacts 2b and 3b are open.

Opening of contacts 4b deenergize winding 7w of relay 7, but contacts 7a remain momentarily closed because of the delaying action of capacitor 7x.

Opening of contacts 4c opens the circuit of counter 14 completing the counting impulse.

Closure of contacts 4m with contacts 7a momentarily held closed by capacitor 7x causes momentary operation of relay 8. Relay 8 then momentarily opens its normally closed contacts 8m unlocking reverse registration relay 6 if this relay is locked in by a reverse count as described below.

This completes the normal forward counting of a single can. Successive forwardly moving cans are counted in the same manner.

## COMPLETE REVERSE REGISTRATION

*Condition D.—Reverse approach starting from Normal*

Assuming that with switches 12 and 13 open, the direction of flow reverses, master relay 2 then operates from switch 13. Closure of contacts 2a and 2b is ineffective. Closure of contacts 2c operates reverse interlock relay 5 through the closed contacts 1n of master relay 1.

Opening of contacts 2m is ineffective, because contacts 1a are open.

Opening of contacts 2n is ineffective because contacts 1c are open.

Operation of reverse interlock relay 5 causes closure of contacts 5a and 5b.

Closure of contacts 5a prepares a locking circuit for relay 5.

Closure of contacts 5b partially prepares an operating circuit for reverse registration relay 6.

*Condition C.—Overlap starting from reverse approach*

With switch 13 closed, the backwardly moving can next closes switch 12. This causes operation of master relay 1 with master relay 2 already operated.

Closure of contacts 1*a* is ineffective because contacts 2*m* are open.

Closure of contacts 1*b* completes a locking circuit through the closed contacts 5*a* of reverse interlock relay 5.

Closure of contacts 1*c* is ineffective because contacts 2*n* are open.

Opening of contacts 1*m* is ineffective because contacts 3*b* and 4*a* are open.

Opening of contacts 1*n* transfers control of the locking circuit for reverse interlock relay 5 from master relay 2 to master relay 1. When contacts 1*n* open, the delay capacitor 5*x* connected across the operating winding 5*w* of relay 5 holds locking contacts 5*a* closed until relay contacts 1*b* have closed. Alternatively, a make before break sequence between contacts 1*b* and 1*n* will produce the same result.

*Condition B.—Forward approach, starting from reverse approach*

The backwardly moving can proceeds until switch 13 opens contacts 13*c* with contacts 12*c* still closed. Master relay 2 releases while master relay 1 remains operated, opening contacts 2*a*, 2*b* and 2*c* and closing contacts 2*m* and 2*n*.

Opening of contacts 2*a* is ineffective because contacts 3*a* are open.

Opening of contacts 2*b* is ineffective because contacts 3*b* are open.

Opening of contacts 2*c* is ineffective because contacts 5*a* and 1*b* are closed, holding reverse interlock relay 5 locked in.

Closure of contacts 2*n* operates reverse registration relay 6 through the closed contacts 1*c* of master relay 1 and the closed contacts 5*b* of reverse interlock relay 5. Reverse registration relay 6 closes its contacts 6*a* thereby locking itself operated under control of reverse registration release relay 8 until completion of the next full forward count, at which time contacts 8*m* will open momentarily as described above.

Operation of reverse registration relay 6 also causes opening of its normally closed contacts 6*m* which are connected in series with the circuit of counter 14 which is thereby prevented from registering a further count until reverse registration relay 6 has been released.

*Condition A.—Normal, reached in reverse sequence*

If the can which caused operation of reverse registration relay 6 continues to move backwardly until contacts 12*c* of switch 12 open, then the entire circuit resets to normal preparatory to another forward count. The next forward count, however, will be suppressed by open contacts 6*m* until after relay 6 has been released which takes place after completion of the next forward count. This forward count will be registered by the can which moved backward through a sufficient distance to operate reverse registration relay 6. A further can may move backwardly provided that it does not move far enough to cause another resetting of the relay circuit in readiness to start another forward count, the backward moving counting storage capacity being limited to one and a fraction cans in the embodiment of the invention herein illustrated. The reverse counting capacity may be enlarged, if required, by the inclusion of a conventional counting relay chain which counts up in response to each operation of relay 6 and counts down in response to each operation of relay 4, contacts 6*m* being held open during the time when a count of one or more is stored in the counting chain. Counting chains of this character are well known in the art. Alternatively, reversible stepping switches may be used, if desired, the stepping switch having a count up magnet controlled by or along with relay 6 and a count down magnet controlled by or along with relay 6 and a count down magnet controlled by or along with relay 4, the contacts 6m being conventional off-normal contacts of the stepping switch.

In the embodiment illustrated, however, a reverse count capacity of one and a fraction cans is sufficient conditions encountered in practice.

*Partial reverse movements*

The situation will be considered in which a container moving in the forward direction, closes switch 12, then closes switch 13 and thereafter allows switch 12 to open causing energization of counter 14, but reverses its direction without allowing switch 13 to open for complete registration of the count.

If the container moves backward far enough to reclose switch 12, then open switch 13 and finally open switch 12, the relays will operate in the same manner as if a complete passage were made in the reverse direction since the sequence commences with switch 13 closed and proceeds in the reverse direction. However, as the can deactuates switch 13, reverse registration relay 6 is operated and locks in pending completion of the next full forward count as described above.

When reverse registration relay 6 operates, its contacts 6*m* open and deenergize the counter 14, thereby completing registration of the count. The can is therefore free to move under the switches 12 and 13 operating them at will without further actuation of counter 14. Repeated operation of forward counting relay 4 is ineffective because the circuit of counter 14 is open at the contacts 6*m* of reverse registration relay 6. Reverse registration relay 6 is locked in and will not release until the can passes both switches and allows contacts 4*m* of counting relay 4 to close and operate relay 8 before the slow release relay 7 opens its contacts 7*a*. This happens only when the can completes its forward movement past the two switches 12 and 13. This prepares the circuit to count the next can which has not yet been counted.

Alternatively, the can may back past both switches 12 and 13. In this event, the circuit is restored for a new forward count which is suppressed as described above, by the locked in reverse registration relay 6. Thus, no false count is registered.

From the foregoing, it will be seen that repeated backward and forward movements of any one can under the switches will not result in a false count, regardless of the extent of such movements. In the embodiment of the invention illustrated in Fig. 3, however, the extent of such movements cannot exceed more than one and a fraction of a can without the provision of storage capacity for more than a single reverse count.

If the can has actuated only one of the switches 12 or 13, it may move away in such a direction that both switches are not actuated simultaneously without producing any effect on the counting action.

If the can reaches the overlap condition where both switches are simultaneously actuated, reciprocatory movement actuating and deactuating only switch 12 will not effect the counter because relays 3 and 4 are locked in under control of master relay 2 and switch 13. If the can reciprocates so that only switch 13 and master relay 2 are repeatedly actuated and deactuated, switch 12 being held closed and master relay 1 held operated, then forward counting relay 14 cannot follow this action because it is prevented by contacts 1*m* of master relay 1 from operating until relay 1 releases with master relay 2 operated.

If the reciprocating movement is such that from the overlap condition with both master relays 1 and 2 operated, first one is released and then the other, a single complete count will be registered and any further count will be prevented by locking in of reverse registration relay 6 which opens the circuit of counter 14 by its contacts 6*m*.

If the reciprocating movement carries the can back and

forth completely past both switches without permitting another can to move past the overlap condition, then the first complete backward passage will cause the reverse registration relay **6** to cancel out the count for the next complete forward passage.

While I have illustrated preferred embodiments of the invention, modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

I claim:

1. Counting apparatus for counting objects moving along a common path, said apparatus comprising directionally responsive object sensing means disposed in proximity to said path, a counter, count controlling means connected between said sensing means and said counter for actuating said counter in response to an object moving forwardly along said path, and count suppressing means controlled by said sensing means in response to an object moving backwardly along said path for preventing said counter from being actuated by the next forwardly moving object, said object sensing means comprises two switches disposed in proximity to said path for successive actuation and deaction by a moving object, said switches being further arranged for simultaneous actuation by each moving object, said count controlling means being responsive to deactuation of a first one of said switches with a second one of said switches actuated, and said count suppressing means being responsive to deactuation of said second switch with said first switch actuated.

2. Apparatus according to claim 1, further comprising locking means responsive to operation of said count suppressing means for maintaining suppression of said count, and restoring means for unlocking said locking means, said restoring means being responsive to deactuation of said first switch immediately followed be deactuation of said second switch.

3. Counting apparatus for counting objects moving along a common path, said apparatus comprising: object sensing means disposed in proximity to said path, said sensing means including a first control means actuable by an object to be counted moving forwardly along said path and a second control means actuable by said object as it proceeds further along said path, said first control means remaining actuated after actuation of said second control means, said first control means becoming deactuated after said object has proceeded still further along said path, said second control means remaining actuated after deactuation of said first control means and becoming deactuated in response to still further forward movement of said object along said path, the sequence of operation of said control means being opposite to the sequence aforesaid for an object moving backwardly along said path; forward count control means responsive to deactuation of said first control means with said second control means actuated; reverse count control means responsive to deactuation of said second control means with said first control means actuated; a counter controlled by said forward count control means; means controlled by said reverse count control means for suppressing operation of said counter; and restoring means responsive to operation of said forward count control means for terminating said suppression of said counter operation.

4. Apparatus according to claim 3, wherein said object sensing means comprises a plurality of switch means disposed for succesive operation by an object moving along said path.

5. Apparatus according to claim 3, wherein said restoring means is responsive to operation of said forward count control means immediately followed by deactuation of said second control means.

6. Apparatus according to claim 5, in which said counter operation suppressing means comprises locking means, said locking means being unlocked by operation of said restoring means.



7. Apparatus according to claim 3, in which said common path includes inclined chute means for moving said objects forwardly along said path at varying speeds which may become so high that an obstruction along said path may cause said objects to rebound sufficiently to move at least one of said objects past said sensing means in the backward direction.

8. Counting apparatus for counting moving objects traveling along a common path, said apparatus comprising: object sensing means disposed in proximity to said path, said sensing means including a first circuit control means actuable by an object to be counted moving forwardly along said path and a second circuit control means actuable by said object as it proceeds further along said path in said forward direction, said first circuit control means remaining actuated after actuation of said second circuit control means, said first circuit control means becoming deactuated after said object has proceeded still further along said path, said second circuit control means remaining actuated after deactuation of said first circuit control means and becoming deactuated in response to still further forward movement of said object, the sequence of operation of said circuit control means being opposite to the sequence aforesaid for an object moving backwardly along said path; a first relay means responsive to actuation of said first circuit control means with said second circuit control means deactuated; a second relay means controlled by said first relay means and responsive to deactuation of said first circuit control means with said second circuit control means actuated; counting means controlled by said second relay means; a third relay means responsive to actuation of said second circuit control means with said first circuit control means deactuated; a fourth relay means controlled by said third relay means and responsive to deactuation of said second circuit control means with said first circuit control means actuated, said fourth relay means including means for suppressing operation of said counting means and locking means for keeping operation of said counting means suppressed; and restoring means responsive to deactuation of said first circuit control means followed by deactuation of said second circuit control means for unlocking said fourth relay means.

9. Counting apparatus according to claim 8 wherein said restoring means comprises a fifth slow acting relay means controlled by said second relay means and a sixth fast acting relay means including means for unlocking said fourth relay means, said sixth relay means being controllable by said second relay means for a time interval determined by said slow time of action of said fifth relay means.

10. Counting apparatus for counting objects moving along a common path, said apparatus comprising object sensing means disposed in proximity to said path, said sensing means including a first control means actuable by an object to be counted moving forwardly along said path and a second control means actuable by said object as it proceeds further along said path, said first control means remaining actuated after actuation of said second control means, said first control means becoming deactuated after said object has proceeded still further along said path, said second control means remaining actuated after deactuation of said first control means and becoming deactuated in response to still further forward movement of said objects along said path, the sequence of operation of said control means being opposite to the sequence aforesaid for an object moving backwardly along said path; forward count control means responsive to deactuation of said first control means with said second control means actuated; reverse count control means responsive to deactuation of said second control means with said first control means actuated; a counter controlled by said forward count control means; means con-

trolled by said reverse count control means for preventing said counter from counting a forward movement of said object which would be counted if a backward movement of an object had not occurred.

11. Counting apparatus for counting objects moving along a common path, said apparatus comprising object sensing means disposed in proximity to said path, said sensing means including a first control means and a second means, said first control means and then said second control means being actuable by an object moving forwardly along said path, said first control means and then said second control means becoming deactuated in response to forward movement of said object along said path, the sequence of operation of said control means being opposite to the sequence aforesaid for an object moving backwardly along said path; forward count control means responsive to deactuation of said first control



means prior to deactuation of said second control means; reverse count control means responsive to deactuation of said second control means prior to deactuation of said first control means; a counter controlled by said forward count control means; means controlled by said reverse count control means for suppressing operation of said counter; and means responsive to operation of said forward count control means for terminating said suppression of said counter operation.

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