Dec. 17, 1968 L. SVOBIDA 3,416,640

AUTOMATIC DIVIDER

Filed Feb. 24, 1965 2 Sheets-Sheet 1

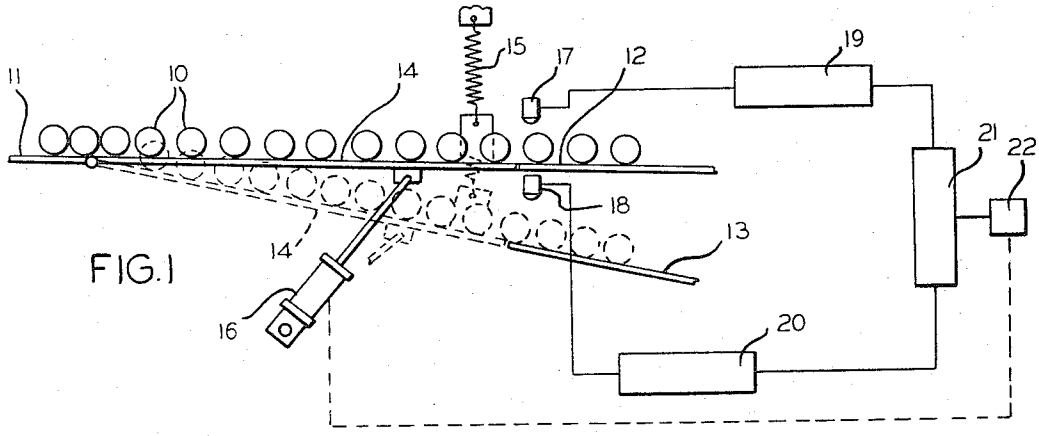

FIG. 1

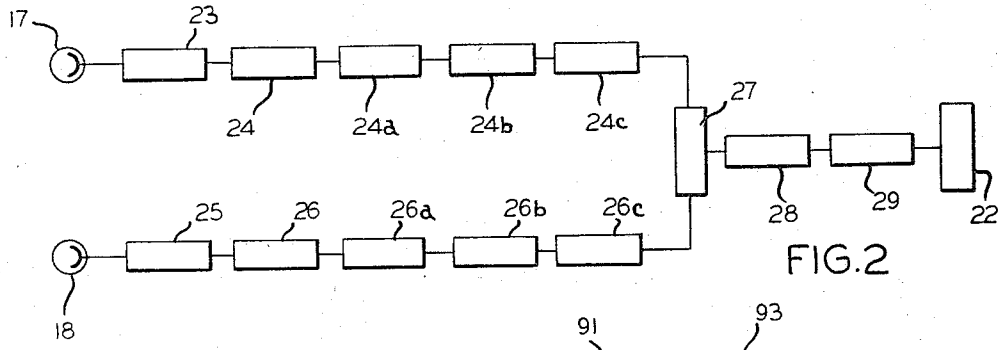

FIG. 2

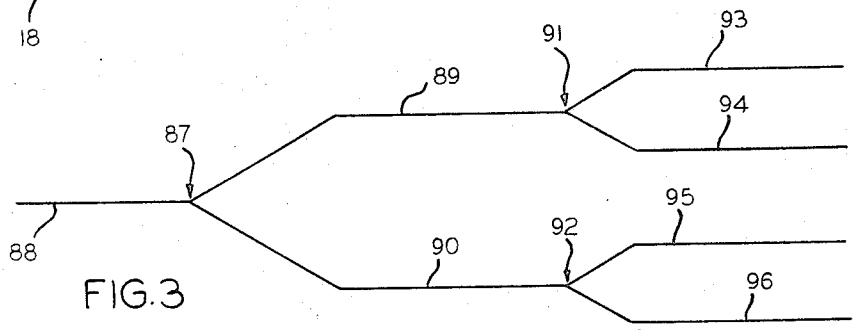

FIG. 3

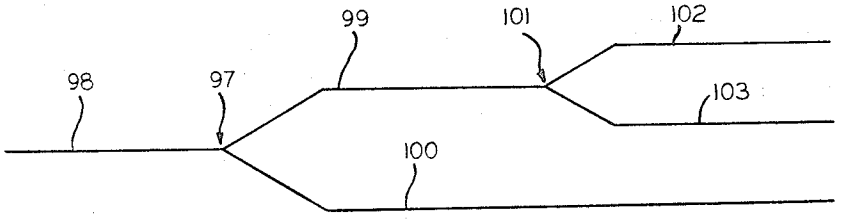

FIG. 4

INVENTOR
LOREN SVOBIDA

BY
Marzall, Johnston, Cook & Root
ATTORNEYS

Dec. 17, 1968 L. SVOBIDA 3,416,640

AUTOMATIC DIVIDER

Filed Feb. 24, 1965 2 Sheets-Sheet 2

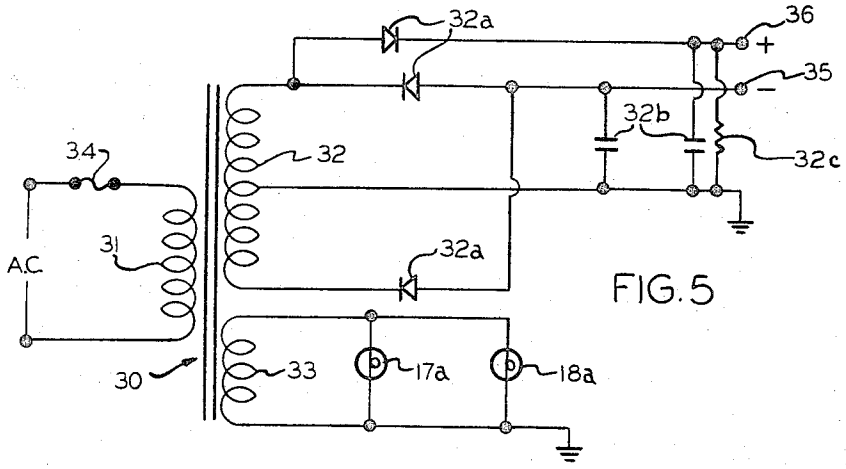

FIG. 5

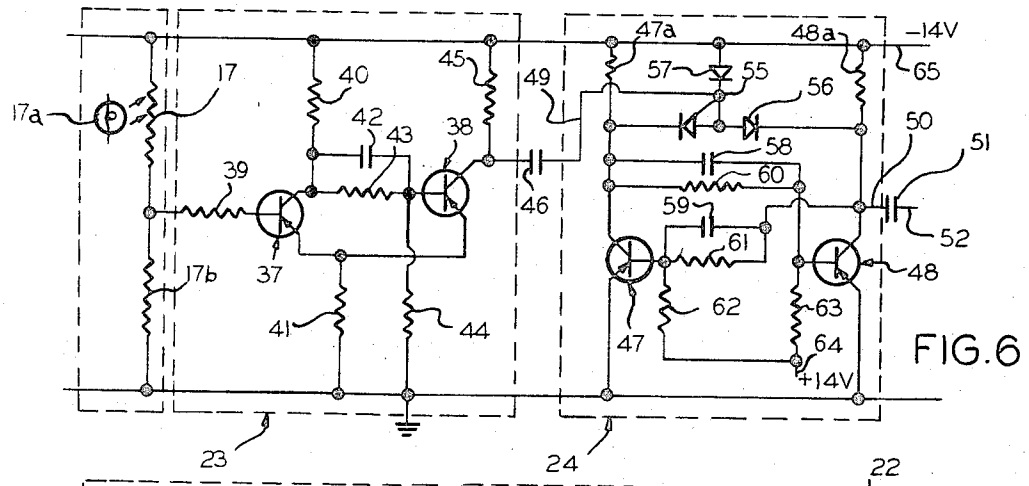

FIG. 6

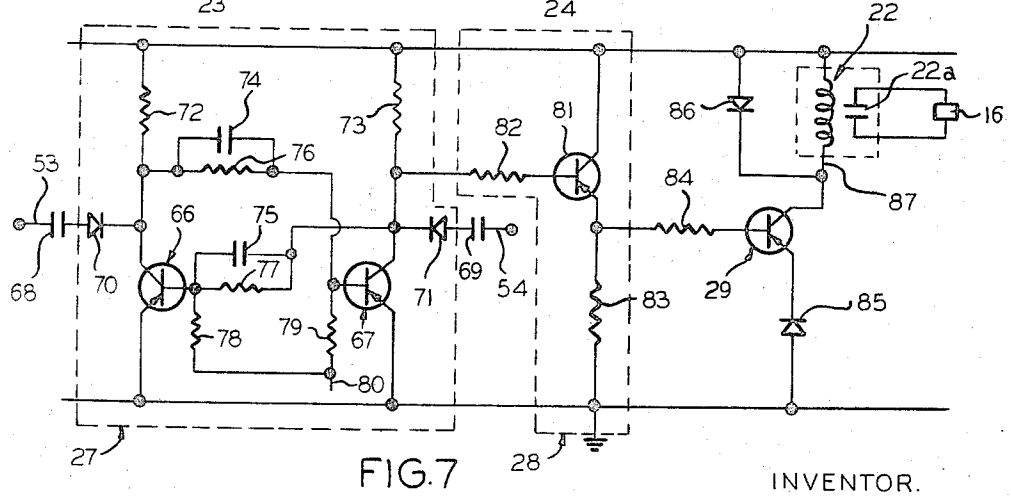

FIG. 7

INVENTOR.
LOREN SVOBIDA

BY
Merrill, Johnston, Cook & Root
ATTORNEYS

United States Patent Office 3,416,640 Patented Dec. 17, 1968

3,416,640

AUTOMATIC DIVIDER

Loren Svobida, 1837 W. 88th St., Chicago, Ill. 60620

Filed Feb. 24, 1965, Ser. No. 434,929
6 Claims. (Cl. 198—31)

ABSTRACT OF THE DISCLOSURE

A divider for dividing articles moving along a first conveyor line onto two second conveyor lines. Self-correcting and self-compensating counter means associated with each second conveyor line to actuate the divider.

This invention relates in general to an automatic divider, and more particularly to a device for dividing articles moving along a single conveyer line between two conveyer lines in accordance with a predetermined division ratio.

While the present invention has many applications, it is especially useful in a cannery or operation where cans are conveyed from a labeling machine to a case packer. In this application, it is usually desirable to divide the line of cans moving from the labeling machine into two or more lines for feeding into the case packer. The present invention is capable of dividing a single line of cans into a double line evenly or in accordance with a predetermined ratio at high speed. Usually in an installation where cans are divided from a single primary line into a pair of secondary lines, a gate is provided to direct the cans from the primary line into either of the two secondary lines. The present invention involves counting of the cans as they enter the secondary lines and thereafter operating the gate to divert the cans into either of the secondary lines in accordance with the number desired in each line.

More particularly, the present invention includes solid state circuitry detecting the movement of cans in the secondary lines and thereby operating the positioning of the gate to divert the cans from the primary line into the desired secondary line. Normally an even division of cans will be employed. The solid state circuitry includes a photoelectric detector for each line that detects the cans moving therealong, and each detector operates a feedback driver to drive binary counters. The binary counters for each secondary line in turn drive a bi-stable oscillator which is coupled to a power transistor by an emitter follower and drives the latter. The emitter follower drives the power transistor which operates a relay that in turn controls a solenoid for positioning of the gate at one of the secondary lines. Assuming that the binary counters are such as to count sixteen cans, after sixteen cans have passed by the photoelectric detector on one of the secondary lines, the gate is actuated to divert the flow of cans to the other secondary line. If more than sixteen cans happen to pass along the first secondary line before switching of the gate, this count will be stored in the binary counters of that line and thereafter included in the next count of sixteen. And at that time if the counters have stored a count of two, only fourteen more cans pass through the gate before it is switched to the other secondary line. Thus, the division of cans between the two secondary lines is automatically corrected as the gate switches back and forth.

Heretofore, dividers have been employed for dividing articles in conveyer lines and where the articles are divided into two lines, but such dividers have been slow in operation thereby causing malfunctioning of the overall conveyer line and costly shutdowns. In these installations the cans are often damaged by jamming of the cans, and these damaged cans sometimes go unnoticed into the cases and are thereafter put on the market.

In one specific example, it has been customary to use mechanical flip-flops to divide the cans from one primary line leading out of a case packer into two secondary lines and then further divide with additional flip-flops. Such mechanical flip-flops have a top speed of only 600 to 700 cans per minute. The very nature of the flip-flops is such as to damage many cans which often go undetected. In addition such mechanical flip-flops have a tendency to jam up, causing costly delays.

It is therefore an object of the present invention to provide a new and improved automatic divider for dividing articles from a single primary conveyer line into a plurality of secondary conveyer lines, and to obviate the above named difficulties.

A further object of this invention is in the provision of an automatic divider for dividing a line of articles into two lines in accordance with a predetermined ratio.

Still another object of this invention is in the provision of an automatic divider for dividing articles moving along a single primary conveyor line into a pair of secondary conveyor lines, wherein the division between the lines may be even.

A further object of this invention is to provide an automatic divider for controlling the movement of articles from a single primary conveyer line to a pair of secondary conveyer lines which is self-correcting if more than the intended count of articles happens to pass to any one secondary conveyer line.

A still further object of this invention resides in the provision of an automatic divider for dividing articles from a single primary line into a pair of secondary lines wherein the articles may be cans or the like and wherein the invention eliminates damaged cans, increases the speed of operation by a material amount, and accurately divides the articles into the secondary line.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like reference numerals refer to like parts, in which:

FIG. 1 is a diagrammatic view of the present invention as applied to a conveyer for dividing the movement of articles from a single primary conveyer line to a pair of secondary conveyer lines;

FIG. 2 is a block diagram of the electrical circuitry of the present invention;

FIG. 3 is a schematic diagram illustrating the dividing of one line into two equal lines and the dividing of the two lines further into four equal lines as an application of the present invention;

FIG. 4 is a schematic diagram illustrating the dividing of one line into two first and second unequal lines and the further dividing of the first unequal lines into two equal lines of the same number as the second unequal line; and

FIGS. 5, 6 and 7 are electrical schematic diagrams of the circuitry of the invention.

Referring now to the drawings and particularly to FIG. 1, an application of the present invention is illustrated in connection with the movement of cans **10** by gravity along a primary conveyer line **11** and to first and second secondary conveyer lines **12** and **13**, wherein a gate or guide means **14** of any suitable type is operated to shift the discharge end of the primary line **11** selectively into communication with the intake ends of the first and second secondary conveyer lines **12** and **13**. Thus, when the gate **14** is in the position shown in solid lines in FIG. 1, the cans from the primary conveyer line **11** will be directed to the first secondary conveyer line **12**, while when the gate **14** is in the position shown in

dotted lines, the cans from the primary conveyer line **11** will be directed to the secondary conveyor line **13**. A spring member **15** serves to normally position the gate **14** in alignment with the first secondary conveyer line, while an actuator in the form of a solenoid in the illustrated embodiment and designated by the numeral **16** will shift the gate **14** into alignment with the second secondary conveyer line **13** when it is energized. De-energization of the solenoid permits the return of the spring **15** to bring the gate **14** back in alignment with the first secondary conveyer line **12**. While a return spring and solenoid arrangement is shown for shifting the gate **14** between its first and second positions, it should be appreciated that other known actuating means may be provided if desired.

A photoelectric device or detector **17** is positioned at the inlet end of the secondary conveyer line **12**, while a photoelectric device or detector **18** is positioned at the inlet end of the secondary conveyor line **13**. These devices are activated by each can that passes thereby, thereby sending a signal into electronic counters **19** and **20**, respectively, which in turn deliver a signal to a drive circuit **21** that controls the operation of a relay **22** for energizing and de-energizing he solenoid **16** and ulimately causing the shifting of the gate **14** between the first and second secondary lines. Each of the counters **19** and **20** may be set to count the same number of articles or cans or may be set to count different numbers of cans or articles so that the gate may be shifted when the predetermined number has been counted.

More particularly, the photoelectric device **17** feeds a signal to a feed-back driver **23** such as a Schmitt trigger, which in turn, triggers the first flip-flop circuit **24** of a binary counter that in this example includes additional flip-flop circuits **24***a*, **24***b* and **24***c*. Similarly, the photoelectric device **18** feeds a signal to a feed-back driver **25**, such as a Schmitt trigger, which in turn, drives the first flip-flop circuit **26** in a binary counter including additional flip-flop circuits **26***a*, **26***b* and **26***c*. The last flip-flop circuits **24***c* and **26***c* of each of the binary counters in turn actuate a further flip-flop circuit or bi-stable oscillator **27**. The binary counter of the photoelectric device **17** will condition he bi-stable oscillator **27** one way, while the binary counter of the photoelectric device **18** will condition the bi-stable oscillator in an opposite way. An emitter follower **28** couples the bi-stable oscillator **27** to and drives the power transistor **29**, that in turn, operates the relay **22**. While each of the binary couners included in FIG. 2 are shown to have the same number of flip-flop circuits, it should be appreciated that the invention covers an example where the one counter would include more flip-flop circuits than the other. Wherein there are four flip-flop circuits in the binary counters as in the embodiment of FIG. 2, a count of sixteen cans will be made before shifting of the gate **14** to divert the cans to the other secondary conveyer line.

The circuitry is powered by a power supply such as shown in FIG. 5 which includes a transformer **30** having a primary coil **31**, a first secondary center-tapped coil **32** and a second secondary coil **33**. The primary coil **31** is provided with overload protection in the form of a fuse **34** or the like, and is adapted to be connected to a suorce of 110 volt alternating current power. The secondary coil **33** merely powers the exciter lamps of the photoelectric device which may be designated **17***a* and **18***a*, while the secondary coil **32** provides at **35** a full wave, rectified, negative, direct current voltage of about 14 volts and at **36** a half wave, rectified, positive direct current voltage used as a standoff voltage of about 14 volts. Power diodes **32***a*, capacitors **32***b*, and a bleeder resistor **32***c* are provided in the power supply.

Referring now to FIG. 6, upon interruption of the light beam between the exciter lamp **17***a* and the photocell **17**, a signal is fed to the Schmitt trigger **23** to cut off the current flow of the first transistor **37** and turn the second transistor **38** on or in conducting conditions to in turn send a signal into the first flip-flop circuit **24** of the binary counter including flip-flop circuits **24**, **24***a*, **24***b* and **24***c*. It should be appreciated that the Schmitt trigger **25** is the same as the Schmitt trigger **23** and that the electrical circuitry of one of the counters will be the only circuitry specifically described. Further, the flip-flops **24***a*, **24***b* and **24***c* are identical to the flip-flop **24** and are therefore not shown.

Within the Schmitt trigger **23**, an isolation resistor **39** leads to the base of the first transistor **37**, while a collector load resistor **40** is provided in connection with the collector thereof. A common emitter feed-back resistor **41** is provided in connection with the emitters of the first and second transistors. A cross switching capacitor **42** and a cross switching resistor **43** extend between the collector of the first transistor and the base of the second transistor **38**, while a voltage divider resistor **44** extends between the base of the transistor **38** and ground. A collector load resistor **45** is provided for the collector of the second transistor **38**. As already indicated, the first transistor **37** is cut off by operation of the photoelectric cell **17** thereby making the second transistor **38** conducting, and when the photoelectric cell **17** is not interrupted, the first transistor **37** will conduct and cut off the second transistor **38**.

A coupling capacitor **46** connects the output of the Schmitt trigger with the input of the flip-flop circuit **24**. The flip-flop circuit **24** includes a first transistor **47** and a second transistor **48**. These transistors have collector load resistors **47***a* and **48***a*, respectively. Each of the flip-flop circuits additionally include an input **49** and an output **50**, the input **49** being connected to the coupling capacitor **46**, and the output **50** being connected to the coupling capacitor **51** that is in turn connected to the input **52** of the next flip-flop circuit. Any number of flip-flop circuits may be connected together depending upon the count desired for each of the secondary conveyer lines, and the last flip-flop circuit has its output connected to one of the inputs **53** or **54** of the bi-stable oscillator **27**. Each of the flip-flop circuits additionally includes steering diodes **55** and **56**, a recovery diode **57**, cross switching capacitors **58** and **59**, cross switching resistors **60** and **61**, and holdoff resistors **62** and **63**. Standoff voltage is applied at **64** and the regular power voltage is applied at **65**.

Referring now particularly to FIG. 7, the bi-stable oscillator or output circuit **27** includes first and second signal transistors **66** and **67**. Along the input lines **53** and **54**, coupling capacitors **68** and **69**, respectively, and signal diodes **70** and **71**, respectively, are provided. The transistor **66** is provided with a collector load resistor **72**, while the transistor **67** is provided with a collector load resistor **73**.

Additionally, cross switching capacitors **74** and **75**, and cross switching resistors **76** and **77** are provided in the circuit. Holdoff resistors **78** and **79** extend between the bases of the transistors and the holdoff voltage supply **80**, the latter of which would be the same as the holdoff voltage applied at **64** in the flip-flop circuit **24**.

The emitter follower **28** includes a small signal transistor **81** having a base resistor **82** and an emitter load resistor **83**.

A holdoff connecting resistor **84** extends between the output of the emitter follower and the power transistor **29**. A power diode **85** insures complete cut off of the power transistor in the off condition, while a power diode **86** protects the collector of the power transistor from the self-induced voltages generated by the inductive load of the relay coil. The output **87** of the power transistor feeds into the relay **22** having relay contacts **22***a* that when closed energize the solenoid **16**.

In a satisfactorily operating circuit according to the present invention, all of the transistors employed are PNP type, and the transistors employed in the Schmitt trigger **23**, flip-flop circuits **24**, bi-stable oscillator **27** and

emitter follower **28** are small signal transistors, such as the 2N396A type. In the power supply, the power diodes could be 1N540, while the capacitors are 500 microfarads, 25 volt, and the bleeder resistor is 1.5K and 1 watt. A suitable power diode would be a 1N540. A suitable power transistor would be a 2N627. All of the resistors employed may be rated at one-half watt with the following values.

Number of resistor:	Value in ohms
17*b*	4.7K
39	1K
40	3.3K
41	.68K
43	1.8K
44	6.8K
45	2.2K
47*a*	6.8K
48*a*	6.8K
60	15K
61	15K
62	100K
63	100K
72	5.6K
73	5.6K
76	15K
77	15K
78	100K
79	100K
82	1K
83	3.3K
84	1K

Suitable values for the capacitors are as followers:

Number of capacitor:	Capacitors in microfarads
42	.0003
46	.01
51	.01
58	.003
59	.003
68	.01
69	.01
74	.0033
75	.0033

The diodes **70** and **71** are small signal diodes such as 1N67A. The steering and recovery diodes **56** and **57** could be 1N67A.

The operation of the automatic divider of the invention, and particularly the embodiment shown in FIG. 2, wherein there are four flip-flop circuits for each binary counter is as follows assuming that all of the flip-flop circuits are conditioned to receive a count wherein the first transistor of each circuit is "off" and the second transistor is "on," and further assuming that the gate **14** is in the position shown in solid lines in FIG. 1. As the first article passes the photoelectric cell **17**, a signal is imparted to the Schmitt trigger **23** cutting off the first transistor and conditioning the second transistor on to conduct. When the second transistor in the Schmitt trigger conducts, a signal is imparted to the first flip-flop circuit **24** to turn on the first transistor and turn off the second transistor. After the article completes the interruption of the photoelectric cell **17**, the second transistor cuts off and the first one conducts. When the next article interrupts the photoelectric cell beam, the Schmitt trigger operates as above explained and sends a signal to the first flip-flop which then conditions the first transistor to off position and the second transistor to on position, the latter of which triggers operation of the succeeding flip-flop circuit **24***a* to turn the first transistor on and the second transistor off. This sequential operation continues through the remaining flip-flop circuits **24***b* and **24***c* and when the photoelectric cell beam has been interrupted sixteen times, the last flip-flop circuit **24***c* will trigger the bistable oscillator **27** to further operate the power transistor **29** through the emitter follower **28** and cause energization of the relay **22** to close the contacts **22***a*, thereby energizing the solenoid **16** to pull the gate **14** into alignment with the secondary conveyor line **13** as shown in dotted lines in FIG. 1 to thereby divert the movement of articles from the primary conveyer line **11** thereto. Thereafter, the photoelectric cell **18** and its associated Schmitt trigger and flip-flop circuits begin to count sixteen articles in the same manner as the circuitry associated with the first secondary conveyer line **12** to ultimately condition the bi-stable oscillator **27** to cut off the power transistor **29**, thereby de-energizing the relay **22** to open its contacts and de-energize the solenoid **16**. The return spring **15** then returns the gate **14** into alignment with the first secondary conveyer line **12**. More particularly, in the operation of the bi-stable oscillator, if a signal comes in on the input **53**, it will cause the transistor **66** to conduct, the transistor **67** to cut off, the emitter follower transistor **81** to on, the power transistor **29** to on and the energization of the relay **22**. On the other hand, if a signal is sent to the input **54** of the bistable oscillator, it would cause the transistor **67** to conduct the transistor **66** to "off" position, the transistor **81** to off, the power transistor **29** to off and the de-energization of the relay **22**.

With the embodiment of FIG. 2, the articles or cans **10** will be divided equally between the secondary conveyer lines **12** and **13** inasmuch as the binary counters associated with each secondary line are of the same number. It will be appreciated that any number of flip-flop circuits may be arranged in the binary counter of either of the secondary conveyer lines to obtain division of articles between the secondary lines in accordance with any binary ratio. Moreover, where it is desired that the binary counter count an odd number of articles, a suitable feed-back circuit can be employed. For example, if the count is to be nine, four flip-flop stages could be used with a feedback of the sixteenth count to reset the counter to seven where it would count nine to reach the full count of sixteen.

Referring again to the embodiment of FIG. 2, should a greater number of cans pass onto one of the secondary conveyer lines than sixteen or the count of a binary counter, the subsequent cans will be counted and stored in memory in the binary counter. For example, if eighteen cans passed the photoelectric cell **17** before the gate **14** could be shifted, the binary counter of that line would store a count of two and the next time it continues to count the cans, the gate **14** will shift after fourteen cans have been counted. Thus, the automatic divider of the present invention is self-correcting and self-compensating so that the division between the secondary conveyer lines will be as desired at all times.

When setting up the automatic divider of the invention, the counting circuits may be initially set by hand by passing an article or hand of a person through the photoelectric cell beam until the gate switches. However, a zero reset device may be provided for the binary counter if desired.

An example of using the present invention wherein it is desired to split one primary line into four secondary lines is shown diagrammatically in FIG. 3, wherein a gate and divider **87** are provided at the end of the primary conveyer line **88** for evenly dividing eight articles into each of the secondary conveyer lines **89** and **90**. In this instance, the binary counters would include three flip-flop circuits. The secondary conveyer lines **89** and **90** thereafter become primary conveyer lines, wherein one gate and divider **91** are provided at the end of the line **89** and another gate and divider **92** are provided at the end of the line **90**. The gate and dividers **91** and **92** further divide the line into additional secondary lines **93**, **94**, **95** and **96** in an equal manner wherein four articles are directed to each line. The dividers **91** and **92** would have binary counters with two flip-flop circuits. Thus, a divi-

sion would be made to ultimately provide four secondary conveyer lines from a single primary conveyer line. It should be appreciated that the latter lines could again be divided or that the initial counts in secondary lines **89** and **90** may be of any desired binary ratio.

In the diagrammatic illustration of FIG. 4, a gate and divider **97** are provided at the end of the primary conveyer line **98** to bring out a two to one ratio of division wherein sixteen articles are delivered to the first secondary conveyer line **99** to every eight articles being delivered to the second secondary conveyer line **100**. Thereafter, a further division is made in the line **99** by a gate and divider **101** for providing two additional secondary conveyer lines **102** and **103** having a one to one ratio of division wherein eight articles are delivered to one line and then eight to another and so on. The binary counters for the divider **101** would include three flip-flop circuits as would the binary counter for the line **100**, while the counter for the line **99** would include four flip-flop circuits. Thus, a single conveyer line could be split into three conveyer lines of equal division.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention, but it is understood that this application is to be limited only by the scope of the appended claims.

The invention is hereby claimed as follows:

1. In combination with a single primary conveyer line having articles movable therealong, first and second secondary conveyer lines, a gate arranged between the discharge end of the primary line and the receiving ends of the first and second secondary lines for selectively directing the articles from the primary line to one of said secondary lines, and an actuator for driving said gate between said first and second conveyer lines, self-correcting and self-compensating means counting the articles received by said secondary lines and for operating said actuator to divide the articles discharged from the primary line between said secondary lines in accordance with a predetermined ratio, said means comprising, first and second photoelectric devices adjacent the receiving ends of said first and second secondary conveyer lines respectively and arranged to be operated by articles passing thereby, first and second binary counters operated by said devices, and means operated by said binary counters to drive said actuator.

2. In combination with a single primary conveyer line having articles movable therealong, first and second secondary conveyer lines, a gate arranged between the discharge end of the primary line and the receiving ends of the first and second secondary lines for selectively directing the articles from the primary line to one of said secondary lines, and an actuator for driving said gate between said first and second conveyer lines, first counting means at the receiving end of said first secondary line for counting a predetermined number of articles and second counting means at the receiving end of the second secondary line for counting a predetermined number of articles, and means operated in response to the outputs of said counters to drive said actuator for shifting said gate between said secondary lines, said first and second counting means being self-correcting and self-compensating, whereby a greater than the predetermined number count during one cycle of a counter will be held and deducted from the next count thereof.

3. In combination with a single primary conveyer line having articles movable therealong, first and second secondary conveyer lines, a gate arranged between the discharge end of the primary line and the receiving ends of the first and second secondary lines for selectively directing the articles from the primary line to one of said secondary lines, and an actuator for driving said gate between said first and second conveyer lines, self-correcting and self-compensating means for counting the articles received by each secondary line and operating said gate actuator to divide the articles between the secondary lines in accordance with a predetermined ratio, said counting means including first and second photoelectric devices at the receiving ends of said first and second secondary lines respectively responsive to count each article passing thereby, first and second binary counters operated by the first and second photoelectric devices respectively, and means connected to the outputs of said binary counters for driving said actuator.

4. In combination with a single primary conveyer line having articles movable therealong, first and second secondary conveyer lines, a gate arranged between the discharge end of the primary line and the receiving ends of the first and second secondary lines for selectively directing the articles from the primary line to one of said secondary lines, and an actuator for driving said gate between said first and second conveyer lines, self-correcting and self-compensating means for counting the articles received by each secondary line and operating said gate actuator to divide the articles between the secondary lines in accordance with a predetermined ratio, said counting means including first and second photoelectric devices at the receiving ends of said first and second secondary lines respectively, first and second feedback drivers having their inputs respectively connected to said first and second photoelectric devices, first and second flip-flop circuits having their inputs respectively connected to the outputs of said first and second feedback drivers, a bi-stable oscillator having first and second inputs respectively connected to the outputs of said first and second flip-flop circuits, an emitter follower having its input connected to the output of the bi-stable oscillator, a power transistor having its input connected to the output o fthe emitter follower, and a relay having its input connected to the output of the power transistor and having a normally open set of contacts, whereby closing of said contacts operates said actuator.

5. The combination as defined in claim **4**, wherein said actuator comprises a solenoid.

6. In combination with a single primary conveyer line having articles movable therealong, first and second secondary conveyer lines, a gate arranged between the discharge end of the primary line and the receiving ends of the first and second secondary lines for selectively directing the articles from the primary line to one of said secondary lines, and an actuator for driving said gate between said first and second conveyer lines, self-correcting and self-compensating means for counting the articles received by each secondary line and operating said gate actuator to divide the articles between the secondary lines in accordance with a predetermined ratio, said counting means including first and second article detecting devices at the receiving ends of said first and second secondary lines respectively responsive to count each article passing thereby, first and second binary counters operated by the first and second article detecting devices respectively, and means connected to the outputs of said binary counters for driving said actuator.

References Cited

UNITED STATES PATENTS

1,697,757	1/1929	Dahlstrom	198—40
2,493,464	1/1950	Nelson	198—40
2,933,185	5/1960	Coleman	250—209
3,142,761	7/1964	Rabinow	250—209

RICHARD E. AEGERTER, *Primary Examiner.*

U.S. Cl. X.R.

198—40