Aug. 9, 1966 P. J. SCHNEIDER 3,265,901

ELECTRONIC BOTTLE WIDTH SELECTOR

Filed Nov. 26, 1963 3 Sheets-Sheet 1

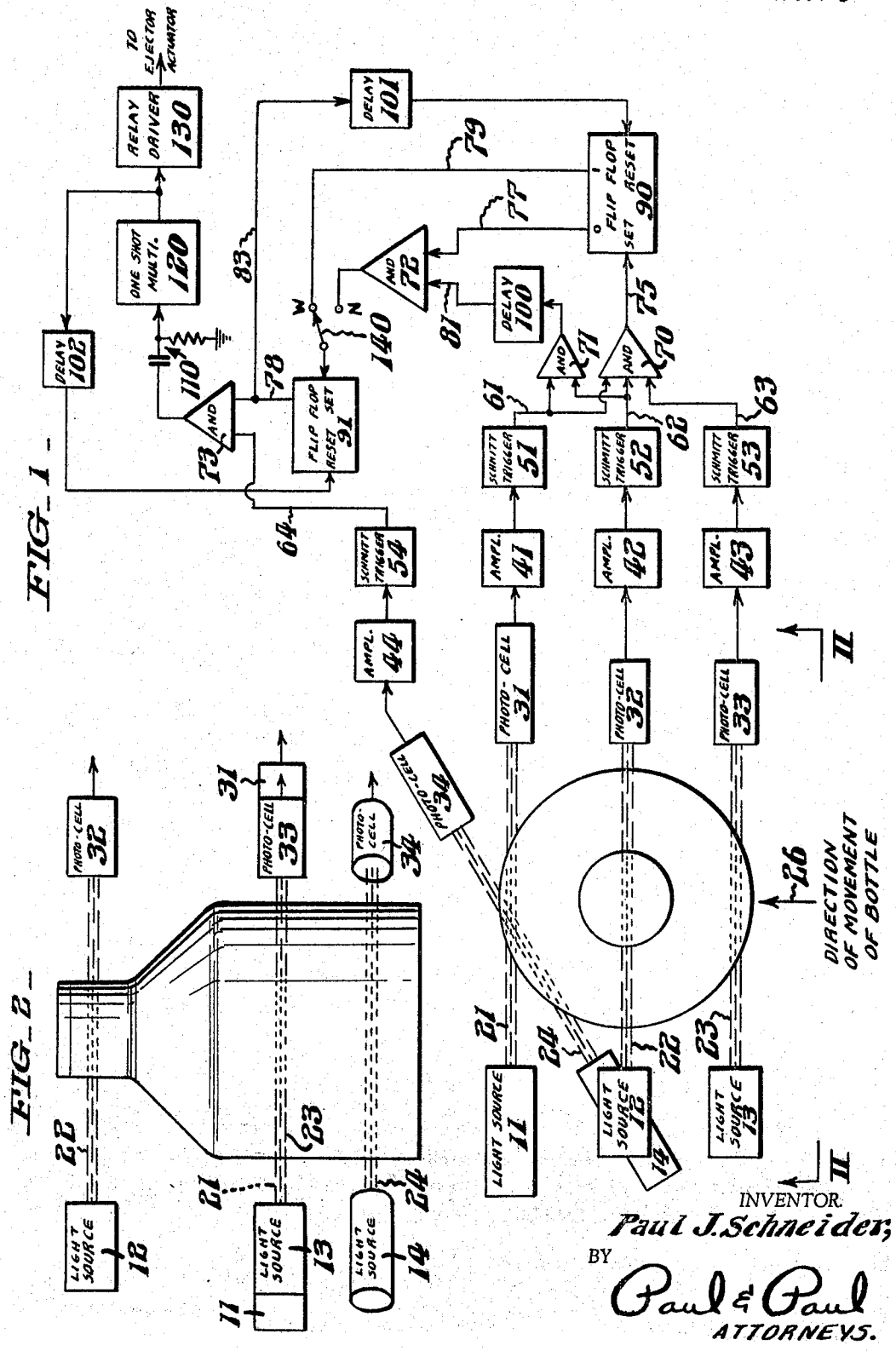

FIG. 1

FIG. 2

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FIG. 3

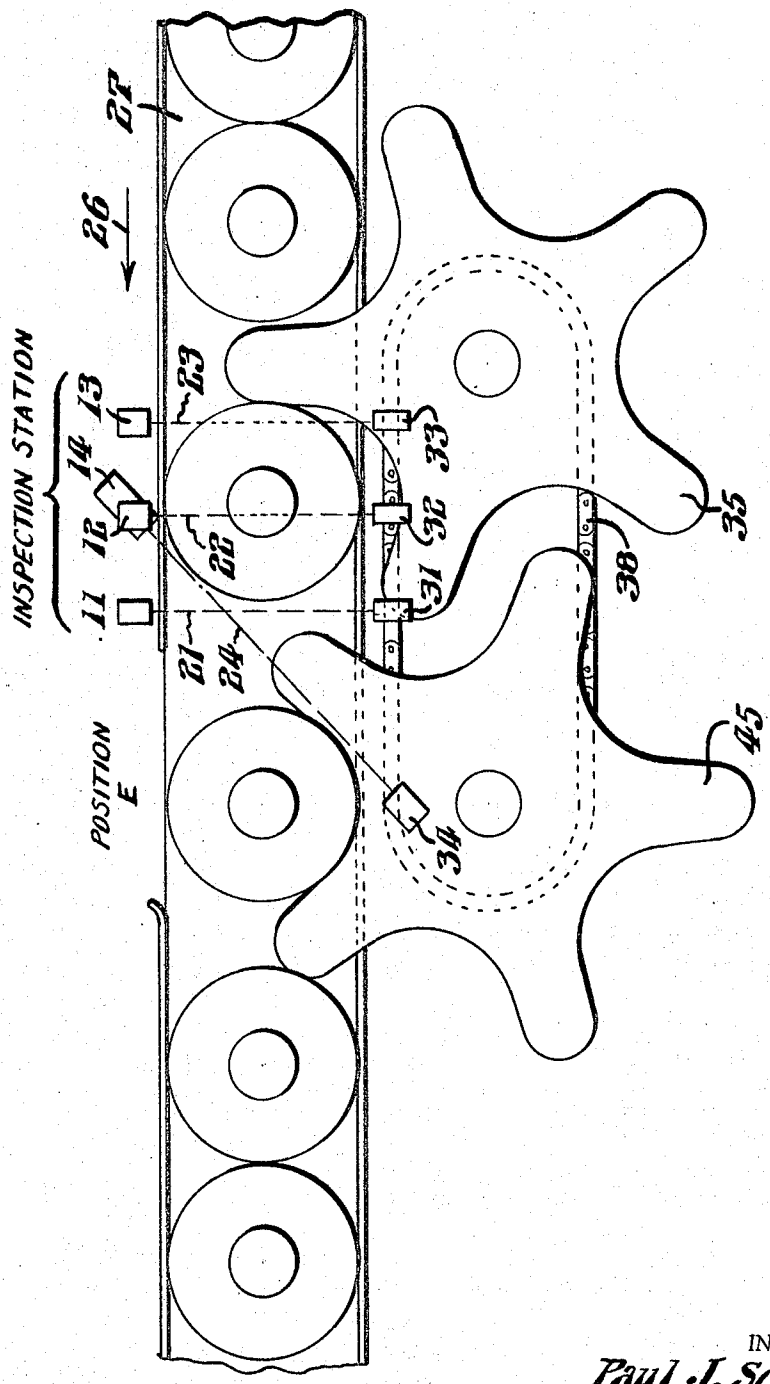

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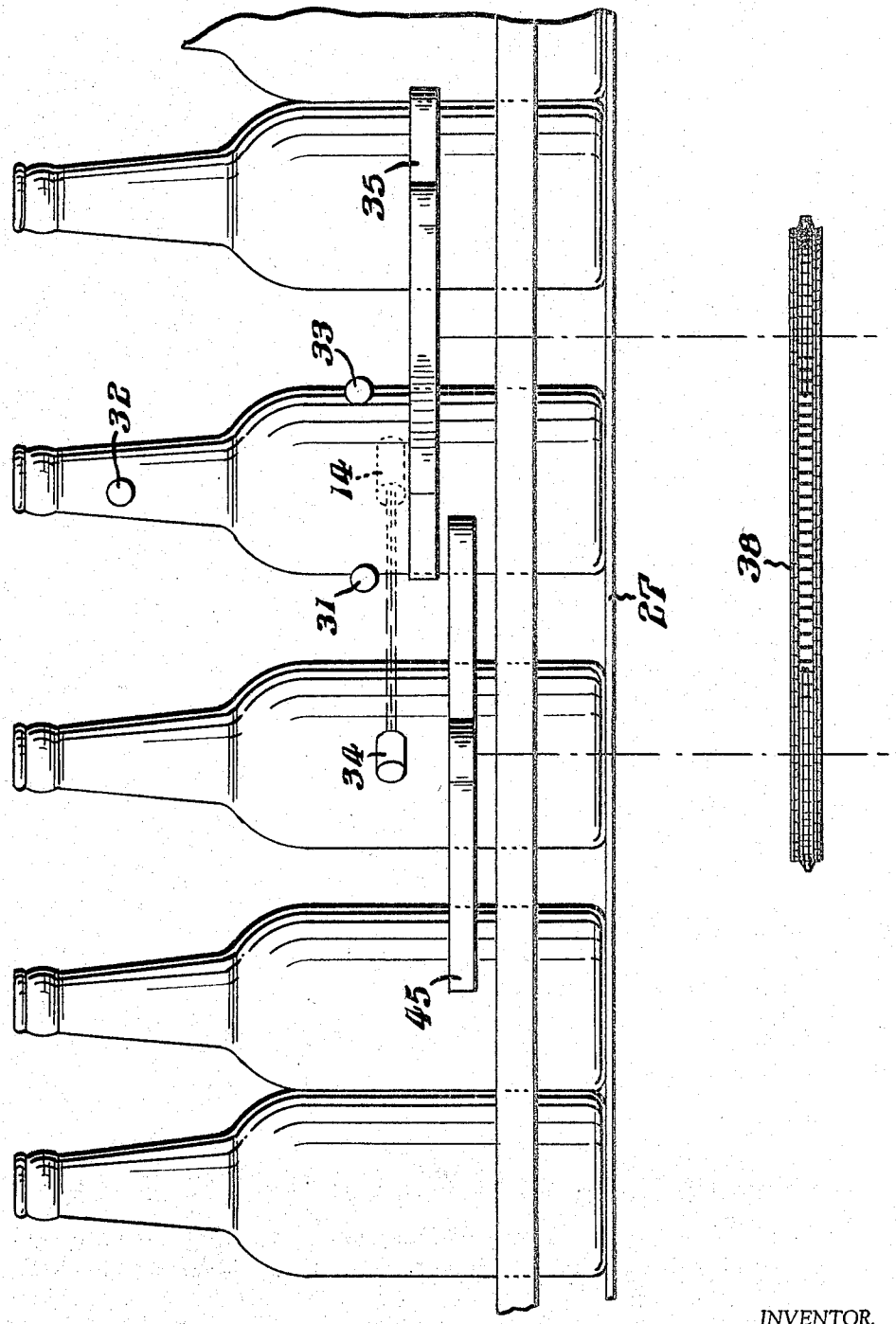
FIG. 4



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3,265,901

ELECTRONIC BOTTLE WIDTH SELECTOR

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9 Claims. (Cl. 250—223)

This invention relates to apparatus for electronically distinguishing between bottles of different diameter or width.

The apparatus is particularly suited for recognizing and distinguishing between bottles which may be similar in all respects except outside diameter. For example, the 10 oz. and 12 oz. Pepsi-Cola bottles in present use are made of the same type and color of glass, have the same swirl configuration, are of the same height, have the same general outline, and differ only in width or diameter. The apparatus of the present invention is adapted, for example, to recognize and distinguish between the 10 oz. and 12 oz. Pepsi-Cola bottles.

The apparatus of the present invention makes use of light beams, light sensitive devices, optic elements and electronic circuits to generate an electrical control or recognition signal. The control signal developed may then be used to actuate a mechanical knockout or removal mechanism, or to channel the bottles of different widths on to different conveyor belts. The present invention is concerned primarily with the means for developing the recognition or control signal. The invention is not concerned with the particular mechanical knockout or other selection means actuated by the developed signal.

In a preferred form, the apparatus of the present invention employs four light beams and four associated circuits, one controlled by each of the four light beams. The apparatus also includes a selection switch manually operated by the operator to control which one of the two types of bottles will be selected and which one will be rejected.

The invention will be clearly understood from the following description and from the drawing in which;

FIG. 1 is a block diagram of the electronic system illustrating diagrammatically a large bottle at the inspection station;

FIG. 2 is a diagrammatic elevational view looking along the line II—II of FIG. 1;

FIG. 3 is a diagrammatic plan view of a dual starwheel arrangement which may preferably be employed to obtain minimum separation between the bottles at the inspection station; and

FIG. 4 is a diagrammatic elevational view of the dual starwheel arrangement of FIG. 3.

Referring now to the drawings, light sources **11**, **12**, **13** and **14** may be any suitable sources capable of projecting the beams of light **21**, **22**, **23**, and **24**, respectively. The light beams may preferably be narrow beams, projected as through slits, and may be produced, for example, by a tungsten bulb, or by a carbon arc, or by an ionized type of light, such as a fluorescent or mercury vapor light. The light sources may be energized by either A.C. or D.C. electrical power.

Light beams **21**, **22**, and **23** are projected preferably along parallel paths and unless intercepted by a modifying surface fall unmodified on the light sensitive devices **31**, **32** and **33**. The light beam **24** from source **14** is projected diagonally along the path indicated in FIG. 3, and unless modified as by an intercepting bottle, is received unmodified on the light sensitive device **34**. The devices **31**, **32**, **33** and **34** may preferably be photo-transistors, but may also be diodes or other photosensitive devices capable of producing electrical output signals corresponding to the variations in light energy received.

The electrical output signals of the photosensitive devices **31**, **32**, **33** and **34** are applied respectively to the

amplifiers **41**, **42**, **43** and **44**, and the outputs of these amplifiers are applied respectively to the Schmitt trigger circuits **51**, **52**, **53** and **54**.

So long as the three parallel light beams **21**, **22** and **23** are falling in full and unmodified form on their respective photo-devices **31**, **32** and **33**, each of the Schmitt trigger circuits **51**, **52** and **53** remains in a state or condition such that the signal level on its respective output leads **61**, **62** and **63** is an inhibit level signal at the AND gate or gates, **70** and **71**, to which said output leads are connected.

When any one of the light beams is intercepted and modified, as by a bottle passing through the station, the electrical output of the phototransistor associated with that beam changes, causing the Schmitt trigger to change its state and causing the output level on its output lead or leads to change to the prime level at the AND gate or gates **70** and **71** to which the leads are connected.

It will be seen that an output signal is developed on the output lead **75** of the AND gate **70**, only when all three of the Schmitt trigger circuits **51**, **52** and **53** are changed to that state which produces a prime level on each of its output leads **61**, **62** and **63**, and that this situation exists only when all three of the parallel light beams **21**, **22** and **23** are intercepted concurrently.

As seen in FIG. 2, the light source **12** is mounted above the positions of the two light sources **11** and **13** at such elevation that the beam **22** will be intercepted by the neck of the bottles rather than by the body of the bottles passing through the inspection station. Light beams **21** and **22**, on the other hand, are positioned at a lower level such that these beams will be intercepted by the body of the bottle.

The light sources **11** and **13** are so spaced laterally that their respective beams **21** and **23** will be concurrently intercepted by a large diameter bottle passing through the inspection station, as depicted in FIG. 1, but will not be concurrently intercepted by a small diameter bottle whose diameter is less than the spacing between the beams **21** and **23**. A small diameter bottle (as well as a large diameter bottle) will, however, concurrently intercept the neck beam **22** and one or the other of the parallel beams **23**, **21**.

When the flip-flop **90** is in a reset state, its output lead **77** is at a prime level and its output lead **79** is at an inhibit level. Output lead **79** is connected to a terminal W and lead **77** is coupled through AND gate **72** to the terminal N of a manual selection switch **140**. The position of the arm of the switch **140** controls whether the wide bottles or the narrow bottles are ejected from the conveyor at ejection position E. When the arm of switch **140** is at the W terminal, the wide bottles are ejected. When the switch arm is at the N terminal, the narrow bottles are ejected. This will become clear as the description proceeds.

In contra-distinction to the three Schmitt trigger circuits associated with photo-cells **31**, **32** and **33**, the fourth circuit, associated with photo-cell **34**, is so arranged that interception of light beam **24** by a bottle will cause the Schmitt trigger circuit **54** to change to a state in which its output signal level on lead **64** will be an inhibit level (rather than at a prime level as in the case of the Schmitt triggers **51**, **52** and **53** when a bottle intercepts their associated light beams).

Light beam **24** is projected by a light source **14** so positioned and oriented that the beam **24** is projected diagonally across the path along which the bottles are moved by the conveyor **27**, the location of beam **24** being clearly shown in FIGS. 1 and 3. The direction in which the bottles move is indicated in FIGS. 1 and 3 by the arrow **26**. The diagonal position of beam **24** relative to that of the three paralleled transverse beams **21**, **22** and **23**, is such

that beam 24 is intercepted by a bottle before beam 21 is intercepted. Beam 24 is also the last of the four beams to be cleared by a bottle. The reason for so aligning the beam 24 will be clear from the following description of the operation of the system.

As a bottle is moved into the inspection station by the conveyor belt 27, the light beam 23 is the first beam to be intercepted by the bottle. Interception of the light beam 23 causes the Schmitt trigger 53 to switch to a state or condition in which its output lead 63 changes from an inhibit level to a prime level. This prime level is applied to AND gate 70.

Neck beam 22 is next intercepted by the neck of the bottle, before the body of the bottle clears beam 23. When neck beam 22 is intercepted, Schmitt trigger 52 is switched and its output lead 62 changes to a prime level, at both of the AND gates 70 and 71. However, neither gate delivers an output signal since lead 61 of Schmitt trigger 51 is still at an inhibit level.

Next, the bottle intercepts the diagonal beam 24, and Schmitt trigger 54 switches to a state in which its output lead 64 changes from a prime to an inhibit level. This inhibits AND gate 73 and prevents an output therefrom so long as diagonal beam 24 remains intercepted.

What happens next depends upon whether the bottle passing through the inspection station is a wide bottle or a narrow bottle. Assume first that it is a wide bottle. Assume further that wide bottles are to be ejected and that selection switch 140 has been placed in that condition which accomplishes the ejection of wide bottles, namely, the arm of switch 140 has been placed at terminal W.

When the wide bottle intercepts beam 21, beams 22 and 23 are still being intercepted. Schmitt trigger 51 switches to a state in which its output lead 61 changes to a prime level, and all input leads at AND gates 70 and 71 are now primed. Thus, both gates deliver an output signal. The output signal from gate 71 is delayed in delay circuit 100 and then applied by way of lead 81 to AND gate 72. The output signal from gate 70 is applied directly to the flip flop 90 to set the flip flop. When flip flop 90 is in the reset state, its output lead 77 is at a prime level and its output lead 79 is at an inhibit level. When the flip flop is set, as just described, its output lead 77 changes to an inhibit level and its lead 79 changes to a prime level.

The purpose of delaying the prime signal from gate 71 in delay circuit 100 is to assure that this prime signal arrives at AND gate 72 after the inhibit level has had time to be established on lead 77 by the setting of the flip flop 90.

It will be seen from the above that a wide bottle places terminal W of switch 140 at a prime level, and places terminal N at an inhibit level. Thus, if the arm of switch 140 is at terminal W, the position shown in FIG. 1, the flip flop 91 will be set. When flip flop 91 is set, its output lead 78 changes to the prime level, and AND gate 73 is primed. No signal is delivered, however, by gate 73 since its other input lead 64 is at an inhibit level, and will remain so until the bottle clears diagonal beam 24.

When flip flop 91 is set, the prime signal on its output lead 78 is also applied by way of lead 83 and delay circuit 101 to the reset terminal of flip flop 90 to reset the flip flop. Delay circuit 101 assures that flip flop 90 will not be reset until flip flop 91 has had time to stabilize in the set state.

As the assumed wide bottle moves on through the inspection station, beams 23, 22 and 21 become cleared and the Schmitt triggers 53, 52 and 51 associated with these beams return to the state in which their output leads 63, 62 and 61 go to the inhibit level. When the bottle finally clears diagonal beam 24, Schmitt trigger 54 returns to the state in which its output lead 64 is at a prime level and AND gate 73 now delivers a change in level signal to the differentiator network 110. The leading edge of this level change is differentiated by network 110 and a short pulse signal is applied to the one-shot multivibrator 120 to trigger it. The output of multivibrator 120 is a pulse of predetermined duration which is amplified in relay driver 130 and then applied to the ejector actuator to actuate the ejector and remove the wide bottle from the conveyor at ejection position E.

It will be understood that if the selector switch 140 had been set at terminal N instead of terminal W, flip flop 91 would not have been set due to the inhibit level signal on lead 77. Hence, the wide bottle would not have caused AND gate 73 to deliver an output signal and the ejector mechanism would not have been actuated.

Assume now that the bottle passing through the inspection station is a narrow bottle, and that the selection switch 140 has been placed at terminal N for the purpose of causing ejection of the narrow bottles.

When the narrow bottle intercepts beams 22 and 23, Schmitt triggers 52 and 53 are triggered and leads 62 and 63 go to the prime level. However, by the time the narrow bottle intercepts beam 21, it is no longer intercepting beam 23. When the bottle clears beam 23, Schmitt trigger 53 switches back to a state in which its lead 63 is at the inhibit level, and this occurs before Schmitt trigger 51 is triggered, by the interception of beam 21, to a state in which its lead 61 goes to the prime level. It will be seen then that at no time are all three input leads to AND gate 70 concurrently at a prime level, and hence no output signal is delivered by the gate 70 to set the flip flop 90. Accordingly, flip flop 90 remains in the reset state, and its leads 77 and 79 remain respectively at the prime and inhibit levels.

Since the narrow bottle does intercept beams 21 and 22 concurrently, Schmitt triggers 51 and 52 are concurrently in the state in which their output leads 61 and 62 are at the prime levels, and accordingly, AND gate 71 delivers an output signal which is delayed in delay circuit 100 and then delivered to AND gate 72 as a prime signal. Since lead 77 of flip flop 90 is at this time at a prime level, the AND gate 72 delivers an output signal and terminal N rises to a prime level. This prime level signal is applied to flip flop 91 to set the flip flop. Its output lead 78 rises to a prime level and AND gate 73 is primed. Its other lead 64 is, however, at an inhibit level since the diagonal beam 24 is being intercepted by the bottle. When the bottle clears diagonal beam 24, Schmitt trigger 54 returns to that state in which its output lead 64 is at a prime level. When this occurs AND gate 73 delivers an output signal to differentiator circuit 110, the one-shot multivibrator 120 is triggered, and the ejector actuator is actuated, thereby to eject the narrow bottle from the conveyor at the ejection position E.

If, with the switch 140 set on the terminal N, the bottle passing through the inspection station is a wide bottle, the ejection actuator will not be actuated, since flip flop 90 will be set, and lead 77 will go to the inhibit level. Thus, the terminal N will not go to the prime level, and flip flop 91 will not be set.

In those instances where flip flop 91 is set, as described above, and the one-shot multivibrator 120 is triggered, the pulse of predetermined duration delivered by the one-shot multivibrator 120 is applied, not only to the relay driver 130 as previously described, but is also applied through the delay circuit 102 to the reset terminal of the flip flop 91 to reset the flip flop. The purpose of the delay is to assure that a complete level change occurs at the output of AND gate 73 before resetting the flip flop 91 and removing the prime level from lead 78.

It will be seen from the foregoing description that the set condition of flip flop 91 controls the generation of the ejector actuator signal, and that the position of selector switch 140 controls the condition under which the flip flop 91 will be set. If switch 140 is placed in position W, the presence of a wide bottle at the inspection station will cause the flip flop 91 to be set. If switch 140 is placed in position N, the presence of a narrow bottle at the inspection station will cause the flip flop 91 to be set.

It will also be seen that, although the condition of flip flop **91** is determined while the bottle is at the inspection station, and although the flip flop **91** is immediately placed in the determined condition, the ejector is not actuated until after the bottle has left the inspection station and has arrived at the ejection position E. This delay is controlled by the diagonal beam **24**, which must be cleared before the AND gate **73** is primed on both of its input leads.

While it is possible to so design the physical arrangement as to eject the unwanted bottles from the conveyor at the inspection station itself, it may be desirable to so design the apparatus as to make it undesirable to eject at the inspection station even though the bottle has been fully identified as being of a type to be ejected. The physical locations of the light sources, photo-cells and starwheels may make ejection at the inspection station undesirable. In such case, the employment of diagonal beam **24** and its associated circuitry make it possible to delay the ejection action until the bottle has moved along on the conveyor beyond the inspection station. This arrangement provides a delay which is of indefinite and variable duration which is highly desirable, since it is desirable that the operator be free to move the conveyor **27** at different speeds, and even to be free to stop the conveyor completely in the event of a difficulty at another point in the processing operation requiring repair or correction.

It is of course important that diagonal beam **24** not be intercepted by the following bottle before the preceding bottle has cleared the beam **24**. This is taken care of by the dual starwheel arrangement shown diagrammatically in FIGS. 3 and 4. As there shown, two starwheels **35** and **45** are employed, oriented as illustrated. An endless chain **38** couples the two starwheels for coordinated rotation. Neither of the starwheels is power driven. As conveyor **27** moves along, a bottle carried thereby encounters one of the prongs of the starwheel **35** and causes the starwheel to rotate, counterclockwise as viewed in FIG. 3. This causes starwheel **45** to rotate also, and in the same counterclockwise direction, due to the chain connection therebetween. The two starwheels do not physically interfere with one another since, as seen in FIG. 4, they are at different levels.

The two starwheels are so spaced laterally, and are so oriented relative to each other, that when a preceding bottle clears diagonal beam **24** and is ready to be ejected through the gap in the rear guard rail of the conveyor, the next following bottle has not yet intercepted the other end of beam **24**.

While the preferred embodiment of this invention has been described in some detail, it will be obvious to one skilled in the art that various modifications may be made without departing from the invention as hereinafter claimed.

Having described my invention, I claim:

1. Apparatus for identifying bottles of different widths, said apparatus comprising; an inspection station having first and second light sources for projecting first and second parallel light beams spaced apart laterally by a distance less than the diameter of the wide bottles to be identified but greater than the diameter of the narrow bottles; conveyor means for transporting bottles to be identified one by one transversely through said first and second beams to intercept said beams; first and second photosensitive devices for receiving light respectively from said first and second light beams and for generating electrical output signals in response thereto; a first bistable flip-flop circuit; electronic means for coupling the output signals of said first and second photosensitive devices to said first bistable circuit to place said bistable circuit in one state or the other according to whether or not said first and second light beams are concurrently intercepted; a second bistable flip-flop circuit; a two-position selection switch having two input terminals and one output terminal; means coupling said two input terminals to opposite sides of said first bistable circuit; means coupling said output terminal of said switch to the input of said second bistable circuit to control the state of said second bistable circuit according to the state of said first bistable circuit and the position of said selection switch; and means for utilizing the output of said second bistable circuit as a signal for ejecting either a wide bottle or a narrow bottle according to the position of said selection switch.

2. Apparatus for identifying bottles of different widths, said apparatus comprising; an inspection station having first and second light sources for projecting first and second parallel light beams spaced apart laterally by a distance less than the diameter of the wide bottles to be identified but greater than the diameter of the narrow bottles; conveyor means for transporting bottles to be identified one by one transversely through said first and second beams to intercept said beams; first and second photosensitive devices for receiving light respectively from said first and second light beams and for generating electrical output signals in response thereto; a first bistable circuit; electronic means for coupling the output signals of said first and second photosensitive devices to said first bistable circuit to place said bistable circuit in one state or the other according to whether or not said first and second light beams are currently intercepted; a second bistable circuit; a two position selection switch having two input terminals and one output terminal; means coupling said two input terminals to opposite sides of said first bistable circuit; means coupling said output terminal of said switch to the input of said second bistable circuit to control the state of said second bistable circuit according to the state of said first bistable circuit and the position of said selection switch; means for utilizing the output of said second bistable circuit as a signal for identifying either a wide bottle or a narrow bottle according to the position of said selection switch; a third light source at said inspection station for projecting a light beam diagonally across the path of said conveyor means, said diagonal beam being so oriented as to be intercepted by a bottle moving through said inspection station before the bottle intercepts the second of said parallel beams and also so oriented as not to be cleared by said bottle until after the bottle clears said second parallel beam; a third photosensitive device for receiving light from said diagonal beam and for generating electrical output signals in response thereto; and electronic gate means for receiving said last-named output signals and for blocking the output of said second bistable circuit so long as said diagonal beam is being intercepted.

3. Apparatus according to claim **2** further characterized by the provision of ejector actuator means just beyond said inspection station, and means for utilizing said identification signal as a signal for controlling the actuation of said ejector actuator means.

4. Apparatus according to claim **3** further characterized in that said electronic means for coupling the output signals of said first and second photosensitive device to said first bistable circuit includes first and second Schmitt trigger circuits respectively and a first logic AND gate for receiving the outputs of both said trigger circuits.

5. Apparatus according to claim **4** further characterized in that said means for coupling one of said input terminals of said switch to one side of said first bistable circuit includes a second logic AND gate; and means coupling the output of said second Schmitt trigger circuit to said second logic AND gate for inhibiting said gate when said second beam is not being intercepted.

6. Apparatus according to claim **5** further characterized by the provision of delay means for coupling the output signal of said second bistable circuit to said first bistable circuit to reset the latter.

7. Apparatus according to claim **6** further characterized by the provision of second delay means for coupling

said identification signal to said second bistable circuit to reset the same.

8. Apparatus according to claim 7 further characterized by the provision of a dual starwheel arrangement for moving said bottles one by one at predetermined spacing through said inspection station and into ejection position.

9. Apparatus according to claim 8 further characterized by the provision at said inspection station of a further light source for projecting a light beam at an elevated level to be intercepted by the neck of the bottle passing through said station; a further photosensitive device for receiving the light from said elevated beam and for generating electrical output signals in response thereto; and

means, including Schmitt trigger means coupled between the output of said further photosensitive device and said first logic AND gate, for applying a prime level signal to said first logic AND gate in response to the interception of said elevated beam.

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