

Nov. 16, 1965

F. L. CALHOUN
INSPECTION APPARATUS

3,218,463

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2 Sheets-Sheet 1

Fig. 1

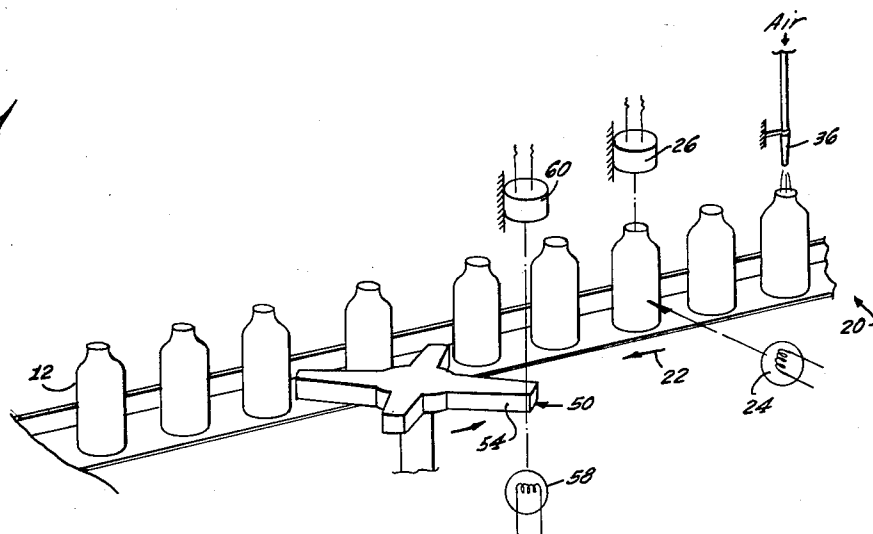


Fig. 2

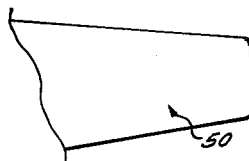


Fig. 3

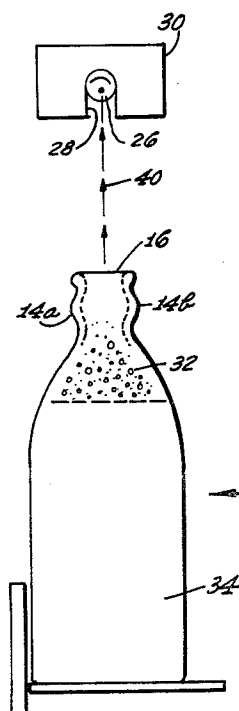


Fig. 4

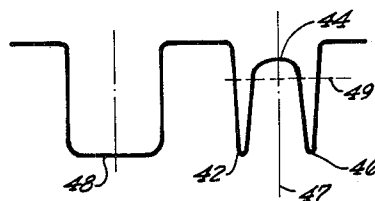
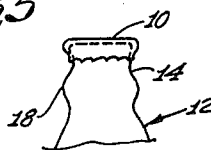


Fig. 5



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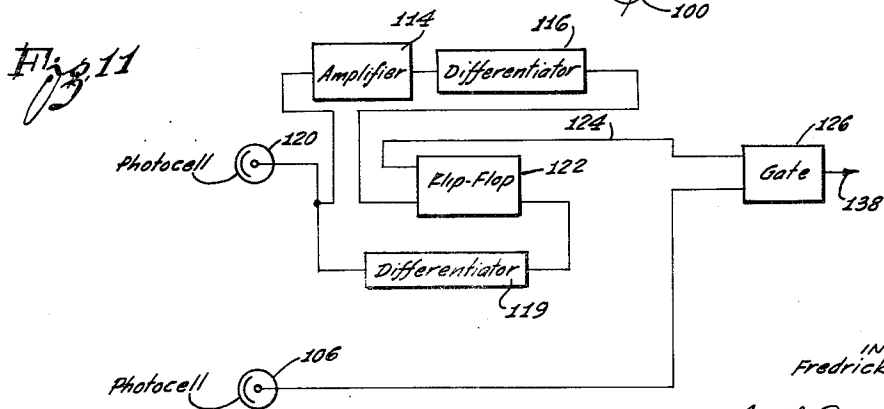
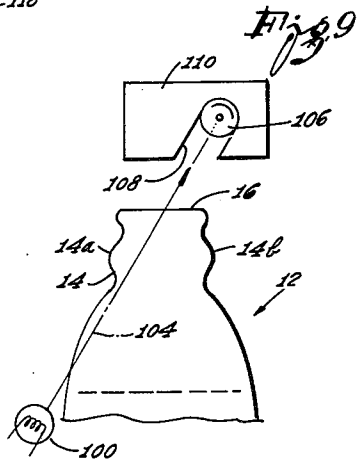
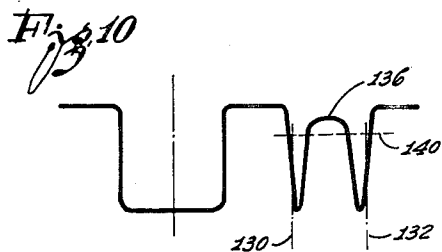
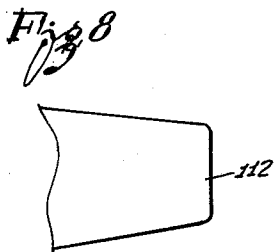
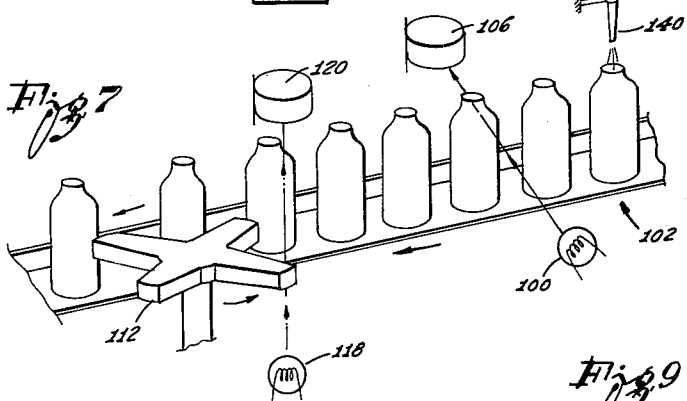
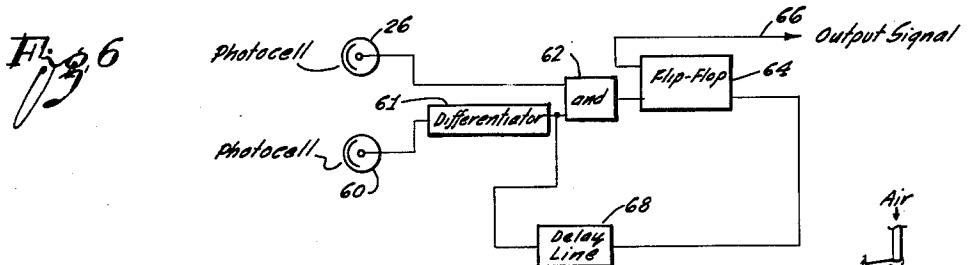
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2 Sheets-Sheet 2



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INSPECTION APPARATUS

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13 Claims. (Cl. 250-222)

This invention relates to apparatus for inspecting containers to determine whether caps have been placed on the mouths of the containers after the containers have been filled with various ingredients such as liquids or solids. More particularly, the invention relates to apparatus for inspecting containers during the movement of the containers along a conveyor line and for operating on the containers during the movement of the containers along the line to provide a positive indication as to the presence of caps on the containers.

Containers are becoming filled increasingly with different ingredients such as liquids on an automatic basis. These liquids may include soft drinks, liquid soaps, cosmetics, food preparations and a considerable number of other items. The containers holding the liquids may be made from various materials including glass and plastics. The containers are cleaned and filled with a liquid during their movement along a conveyor line. As a final step during the movement of the containers along the conveyor line, caps are automatically inserted over the mouths of the containers to seal the containers.

Since the containers are filled automatically during their movement along the conveyor lines, equipment has been devised for testing the filling operation on an automatic basis. For example, equipment has been developed to indicate whether the desired material such as a liquid has been filled to a proper level in the containers. Equipment has also been developed to test for the presence of foreign particles in the container after the container has been filled with the desired material such as a liquid. Such equipment insures that the operation of filling the containers with the desired material such as a liquid is being satisfactorily completed.

Various attempts have been made to develop equipment for indicating whether the cap has been properly inserted over the mouth of the container after the container has been filled with the desired material such as a liquid. The equipment has generally used light which is directed laterally across the mouth of the container toward a photocell disposed in lateral and vertical alignment with the light source on the opposite side of the container from the light source. The photocell has become energized when no cap is present on a bottle since the cap blocks the passage of light between the light source and the photocell.

Although many attempts have been made to develop equipment which will operate satisfactorily to indicate the presence or absence of a cap on the mouth of a container, such attempts have not been entirely successful. One disadvantage has been that the foam existing in the mouth of the container above the level of the liquid in the container has also blocked the passage of light between the light source and the photocell. Because of this, it has been difficult to determine whether the foam or the cap is blocking the passage of light. Another disadvantage has been that the increased thickness of the container at the rim of the container has also inhibited the passage of light from the light source to the photocell. The rims have especially provided difficulty since the heights of the bottles tend to vary somewhat. This has caused the rims of different bottles in the conveyor line to interfere with the passage of light when the light is directed laterally from the source to the photocell.

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This invention provides apparatus which overcomes the above difficulties. The apparatus constituting this invention operates satisfactorily whether the container is made from material such as glass or material such as a plastic. The apparatus constituting this invention also operates satisfactorily regardless of the thickness of the rims defining the mouths of the container and regardless of the amount of foam produced in the mouth of the container during the operation of filling the liquid in the container.

In all of the embodiments included in the invention, energy such as light is directed toward the container so as to pass through the mouth of the container. When a cap is inserted over the mouth of the container, the cap prevents the passage of light through the mouth so as to produce a signal having characteristics different from those produced when a cap is not covering the mouth of the container.

When the container is made from a material such as a plastic, the light may be directed toward the container in a direction transverse to that in which the light passes through the mouth of the container. The light may be directed toward the container in a direction transverse to the mouth since the light becomes diffused or scattered by the liquid in the container. When the container is made from material such as a glass, the light is directed in an oblique direction upwardly through the mouth of the container so as to operate a photocell in the absence of a cap over the mouth of the container. Whether the container is made from glass or a plastic, the foam existing above the level of liquid in the container is removed immediately prior to the movement of the container to the position at which the container receives light from the source. The foam may be removed as by an air stream which is directed downwardly through the mouth in the container. The air stream may be directed downwardly at a position along the conveyor line after the caps have been inserted on the containers. It will be appreciated that an air stream does not have to be provided when the material is filled with a solid, medicinal tablets being one example.

Means are also included in the apparatus constituting this invention for preventing differences in the thicknesses of the container rims from affecting the output indications. Such means include electrical circuitry which provide an output indication only when the light is able to pass through the container without impinging on the rim defining the mouth of the container. In one embodiment, the light from the source is effective in providing an output indication only when the container has reached an intermediate position between the positions in which the opposite diametrical positions on the rim affect the measurement during the movement of the container along the conveyor line. In a second embodiment, an electronic gate is provided which becomes opened when the forward diametrical position on the rim has moved past the position affecting the measurement. The electronic gate then remains open until the position where the rear diametrical position on the rim of the container affects the measurements.

In the drawings:

FIGURE 1 is a schematic fragmentary perspective view of a conveyor system for containers and of apparatus included in the conveyor system and forming a part of this invention for removing foam in the mouths of the containers after the filling of the containers with liquid and for controlling the times during which output signals are produced to represent the presence or absence of caps on the mouths of the containers;

FIGURE 2 is a fragmentary plan view of one finger of a star wheel included in FIGURE 1 for controlling

the times during which the output signals are produced to represent the presence or absence of caps on the mouths of the containers;

FIGURE 3 is a schematic elevational view of one of the containers in the conveyor line and of apparatus including a light source and a photocell for indicating the presence or absence of a cap on the mouth of the container;

FIGURE 4 illustrates waveforms of signals which are produced by the apparatus shown in FIGURES 1, 2 and 3 when a container has a cap covering the mouth of the container and when the container does not have a cap which covers the mouth of the container;

FIGURE 5 is a schematic fragmentary elevational view of a container with a cap covering the mouth of the container;

FIGURE 6 is a circuit diagram illustrating in block form the electrical features of the apparatus shown in FIGURES 1, 2 and 3;

FIGURE 7 is a schematic fragmentary perspective view, similar to that shown in FIGURE 1, of apparatus included in a second embodiment of the invention;

FIGURE 8 is a fragmentary plan view, similar to that shown in FIGURE 2, of a finger of a star wheel included in the apparatus shown in FIGURE 7;

FIGURE 9 is a schematic fragmentary elevational view, similar to that shown in FIGURE 3, of a container and a light source and a photocell included in the embodiment shown in FIGURES 7 and 8;

FIGURE 10 is a view, similar to that shown in FIGURE 4, of waveforms produced when a container with a cap covering the mouth of the container is being tested and when a container without such a cap is being tested; and

FIGURE 11 is a circuit diagram illustrating in block form the electrical features of the invention shown in FIGURES 6, 7, 8 and 9.

The apparatus constituting this invention is adapted to indicate whether caps 10 have been properly disposed on containers 12. The caps 10 may be made from suitable material such as metal or plastic and the containers 12 may be made from a suitable material such as glass or various plastics including polyethylene. The containers 12 are generally provided with rims 14 defining a mouth 16. The mouth 16 is open and is adapted to be closed by the caps 10 which are disposed over the rim 14 defining the mouth and which are generally sealed against the outer periphery of the rim.

The rim 14 of the container 12 is generally defined by a portion of increased thickness, especially when the rim is dimpled as indicated at 18 in FIGURES 3 and 5. Although the apparatus constituting this invention is primarily adapted to be used in testing the presence of caps such as the caps 10, the apparatus constituting this invention may also be used to test for the presence of corks (not shown) which fit into the rim 14 and close the mouth 16 of the container.

The containers 12 are adapted to be moved by a conveyor system generally indicated at 20 in a direction represented by an arrow 22 in FIGURE 1. As the containers are moved by the conveyor system 20 in the direction of the arrow 22, the containers may be cleaned and sterilized and may be filled with a suitable liquid such as a soft drink, a liquid soap, a cosmetic or a food preparation. The containers may also be filled with suitable solids such as medicinal or food preparations. Apparatus for cleaning and sterilizing the containers 12, for filling the containers with a suitable material such as a liquid and for sealing the mouths of the containers with caps are not shown in the drawings since such apparatus is conventional and does not form a part of this invention.

The embodiment shown in FIGURES 1, 2 and 3 is primarily adapted to be used when the containers are made from a plastic although the embodiment may also be used with bottles made from glass. As illustrated in

FIGURE 3, the bottle receives energy such as light from a source 24. This light is illustrated in FIGURE 3 as being beamed toward the bottle in a direction transverse to the mouth of the bottle. However, it will be appreciated that the source 24 may be disposed to beam the light in other directions such as upwardly through the bottom of the bottle.

The light from the source 24 becomes diffused or scattered by the liquid in the container 12. This causes a portion of the light to pass upwardly through the mouth 16 of the container 12 to energy-responsive means such as a photocell 26. The photocell 26 is preferably disposed in a recess 28 of a wall 30 at a position directly above the mouth 16 of the container 12. By disposing the photocell 26 in the recess 28, the photocell becomes sensitive substantially only to the light passing through the mouth 16 of the container 12.

The light passing through the mouth 16 of the container 12 is able to reach the photocell 26 only when no cap 10 has been inserted over the mouth of the container 12. In this way, the photocell 26 provides an indication as to the presence or absence of a cap 10 on the mouth of the container 12. In addition to the cap 10, foam 32 disposed above the level of the liquid 34 in the container is also effective in blocking the passage of light from the source 24 in diffused form through the mouth 16 of the container 12. The foam 32 is produced during the flow of the liquid 34 into the container during the filling operation, especially when the liquid 34 flows in a stream into the container under pressure.

In order to prevent the foam 32 from blocking the passage of the diffused light from the source 24 through the container 12 and the mouth 16 of the container to the photocell 26, means are included in the apparatus constituting this invention for removing the foam from the space above the liquid 34 in the container. Such means include a nozzle 36 which is disposed directly above the mouth 16 of the container 12 at a position before the position at which light from the source 24 is directed toward the container. Air under pressure passes through the nozzle 36 into the mouth 16 of the container to blow away the foam 32.

The nozzle 36 may be disposed at a position beyond that at which the cap 10 is inserted over the mouth 16 of the container 12. This causes the air stream passing through the mouth 16 of the container 12 to be effective in blowing away the foam 32 only on the bottles receiving no cap. The nozzle 36 may be disposed at this position since the foam 32 affects the output indications provided by the photocell 26 only when no cap is present on the container being tested.

Since the rim 14 of the container 12 is provided with a thickened dimension, it tends to block the light passing through the mouth 16 of the container. Because of this, the signal produced by the photocell 26 becomes reduced in amplitude when the forward portion 14a of the rim is disposed in the path of light to the photocell 26, this path being indicated by arrows 40 in FIGURE 3. The reduction of the signal produced at the photocell 26 as a result of the obstruction of the rim portion 14a is indicated at 42 in FIGURE 4.

The container 12 then moves toward the left in FIGURE 3 such that the container becomes disposed in the position indicated in FIGURE 3. In this position, the light is able to pass through the mouth 16 of the container without any obstruction from the rim 14. Under such circumstances, a signal indicated at 44 is produced at the photocell 26 when no cap 10 covers the mouth 16 of the container. The signal 44 is instrumental in obtaining the production of an output signal by the circuitry shown in FIGURE 6 since it is above a minimum level 49 in FIGURE 4.

A further movement of the container toward the left in FIGURE 3 causes the rearward rim portion 14b to be in the path 40 of light so as to obstruct the light

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passing toward the photocell 26. Because of the obstruction provided by the rim portion 14b, the signal produced at the photocell 26 again becomes reduced as indicated at 46 in FIGURE 4.

As will be seen, a pulse 44 is produced at the photocell 26 as a container with no cap on the mouth of the container is moved toward the left by the conveyor system 20. This is in contrast to a signal 48 which is produced at the photocell 26 when a container with a cap 10 covering the mouth 16 of the container is being tested. The signal 48 has a relatively low amplitude during the movement of the entire rim 14 past the photocell 26.

In the embodiment shown in FIGURES 1, 2, 3 and 6, means are provided for determining the signal produced by the photocell 26 only when each container 12 is substantially in the position shown in FIGURE 3. Such means include a star wheel 50 which may be rotatably driven by the containers 12 as the containers are moved by the conveyor system 20. The starwheel 50 includes a plurality of radially disposed fingers 54 which engage the containers 12 in the sectors defined by adjacent fingers and which move the containers toward the left in FIGURE 1.

As each finger rotates, it blocks the passage of light from the source 58 to the photocell 60. At the instant that the finger moves past the blocking position, an electrical signal having a relatively sharp leading edge is produced by the photocell 60. The leading edge of this signal is further sharpened by a differentiator 61 which may be constructed in a manner similar to that disclosed and shown on page 649 of "Waveforms," constituting volume 19 of the Radiation Laboratory Series prepared by the Massachusetts Book Company, Inc., of New York City in 1949.

The signal is produced by the differentiator 61 in FIGURE 6 at a position of the container 12 corresponding to that shown in FIGURE 3 and illustrated at 47 in FIGURE 4. In this way, the photocell 60 produces a signal only at an instant of time when the light from the source 24 is able to pass through the mouth 16 of the container 12 to the photocell 26 without any obstruction by the rim 14.

The signals produced by the photocells 26 and 60 are introduced to an "and" network 62 which may be constructed in a manner similar to that disclosed on page 32 of "Arithmetic Operations in Digital Computers" by R. K. Richards (published by D. Van Nostrand, Inc. of Princeton, New Jersey, in 1955). The "and" network 62 is constructed to produce a signal only when signals are simultaneously introduced to the "and" network from the photocells 26 and 60. This occurs only when the container 12 has no cap 10 and is in the position shown in FIGURE 3. Under such circumstances, a signal passes through the "and" network 62 and triggers a flip-flop 64 to a first state of operation.

The flip-flop 64 may be constructed in a conventional manner, as illustrated on pages 81 to 95, inclusive, of "Digital Computer Fundamentals," by Thomas C. Bartee (published by McGraw-Hill Book Company, Inc., of New York City in 1960). The flip-flop is provided with two stages, each including a current control member such as a vacuum tube or a transistor. When vacuum tubes are used, the plate of each vacuum tube in the flip-flop 64 is coupled to the grid of the other tube such that one of the tubes is conductive at all times when the other tube is non-conductive.

The two stages in the flip-flop 64 may be designated as the left and right stages. Each stage is constructed to receive an input signal and to produce an output signal. The left stage in the flip-flop 64 receives a signal from the "and" network 62 and becomes triggered to a state of non-conductivity so that a signal of relatively high amplitude is produced on an output line 66 connected to the output terminal of that stage.

The right input terminal of the flip-flop 64 receives

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a signal from a delay line 68 which is connected to the differentiator 61. This signal causes the right stage of the flip-flop 64 to be triggered to a state of non-conductivity and the left stage in the flip-flop to be triggered to a state of conductivity so that a signal of relatively low amplitude is produced on the output line 66.

The photocell 60 and the differentiator 61 produce a signal when the position of each container 12 relative to the photocell 26 corresponds to that shown in FIGURE 3. At such a time, a signal passes through the "and" network 62 and triggers the left stage of the flip-flop 64 for the production of an output signal on the line 66, provided that the photocell 26 produces a signal to represent the absence of a cap on the container 12. The output signal on the line 66 is instrumental in actuating equipment which removes the container 12 from the conveyor line. Since such equipment is conventional, it is not shown in detail in this application. In this way, only the containers 12 with caps 10 covering the mouths of the containers are able to be moved by the conveyor line 20 past the star wheel 50.

The system shown in FIGURE 6 is able to test each container 12 for the presence or absence of a cap on the container because the flip-flop 64 becomes triggered to its original state by a signal passing through the line 68. In the original state of the flip-flop 64, the left stage of the flip-flop is conductive so that a signal of low amplitude is produced on the output line 66. The delay line 68 is provided with proper characteristics to return the flip-flop 64 to its original state before the movement of the next container 12 to the position where the photocell 60 produces a signal.

A chopper may be used in the embodiment shown in FIGURES 1, 2, 3 and 6 to interrupt the passage of the light from the source 24 to the photocell 26 at a particular frequency. When a chopper is used, the light received at the photocell 26 has the particular frequency. A circuit tuned to the particular frequency may be accordingly included in the embodiment shown in FIGURE 6 to pass only the signals produced by the light from the source 24 and to reject all extraneous signals.

The energy-responsive system in the apparatus illustrated in FIGURES 7, 8, 9 and 11 is primarily adapted to operate with containers made from glass although it may be also used with containers made from suitable plastics such as polyethylene. The energy responsive system includes a light source 100 which is disposed relative to the containers on a conveyor line generally indicated at 102 to direct light in an oblique direction through the containers. The light from the source 100 passes through each container 12 at a position above the level of the liquid in the container.

The light then passes through the mouth 16 of the container 12 without any obstruction from the rim 14 in at least one position of the container. This is indicated by broken lines 104 in FIGURE 9. After passing through the mouth 16 of the container 12, the light reaches a photocell 106 disposed in a recess 108 of a wall 110 which is positioned above the container 12. The recess 108 is defined by an oblique angle corresponding to the direction at which the light passes through the container 12.

The energy-responsive system discussed in the previous paragraph and illustrated in FIGURE 9 may be used with the electrical system shown in FIGURE 6 and the star wheel arrangement shown in FIGURES 1 and 2. For purposes of convenience, however, the energy responsive system shown in FIGURE 9 is included in a single embodiment with the electrical system shown in FIGURE 11 and the star wheel arrangement shown in FIGURES 7 and 8. It will also be appreciated that the electrical system shown in FIGURE 11 and the star wheel arrangement shown in FIGURES 7 and 8 may be used with the energy responsive system shown in FIGURE 3 and disclosed above.

The star wheel arrangement shown in FIGURES 7 and 8 is similar to the star wheel arrangement shown in FIGURES 1 and 2 such that the star wheel includes a plurality of fingers 112 corresponding to the fingers 54 in FIGURES 1 and 2. When the leading edge of each finger 112 moves to a position blocking the passage of light from a source 118 to a photocell 120, a negative signal is produced by the photocell. This negative signal is inverted by an amplifier 114 and the leading edge of the inverted signal is sharpened by a differentiator 116 to produce a pulse. Upon the movement of each finger past the position blocking the passage of light from the source 118 to the photocell 120, the photocell produces a positive pulse. This pulse is differentiated by a stage 119.

The first electrical pulse produced by the photocell 120 and sharpened by the differentiator 116 during the movement of each finger 112 past the photocell and the light source 118 triggers the left stage of a flip-flop 122 to a state of non-conductivity such that a relatively high voltage is produced on the output line 124. The high voltage on the line 124 opens a gate 126 to obtain a passage of signals from the photocell 106 through the gate. In this way, the gate 126 becomes opened at a position of each container 12 at which the rim portion 14a has moved past the position of obstructing the passage of light from the source 100 to the photocell 106. This corresponds to a time illustrated at 130 in FIGURE 10.

The gate 126 remains open during the time that the container 12 is moving toward the left in FIGURE 9 through a distance in which the light from the source 100 is able to pass to the photocell 106 without any obstruction from the rim 14. The gate 126 becomes closed by the introduction of the second pulse from the photocell 120 to the input terminal of the right stage in the flip-flop 122. This occurs at a time 132 in FIGURE 10. This time corresponds to a position of the container 12 at which the rim portion 14b starts to obstruct the passage of light from the source 100 to the photocell 106. In this way, the gate 126 remains opened only in the interval of time during which each container 12 is disposed relative to the source 100 and the photocell 106 to obtain the passage of light from the source 100 through the mouth of the container to the photocell without any obstruction by the rim 14 of the container.

The signal passing through the gate 126 is controlled by the signal from the photocell 106. When the bottle has no cap covering the mouth 16 of the container, the photocell 106 produces a signal of relatively high amplitude, as illustrated at 136 in FIGURE 10. Since this signal is above a minimum level 140, it causes a signal of relatively high amplitude to be produced at an output line 138 from the gate 126. The signal 136 of high amplitude on the output line 138 is especially able to be produced when the foam in the mouth of the container 12 above the level of the liquid in the container is removed. The foam may be removed as by air passing through a nozzle 140 into the mouth of the container at a position before that at which light from the source 100 is directed through the container to the photocell 106.

As will be seen, the photocell 120 produces a first signal of negative amplitude and a second signal of positive amplitude every time that a finger 112 moves past the source 118. The signal of negative amplitude is able to trigger only the left stage of the flip-flop 122 since the flip-flop 122 is responsive only to positive signals and since the negative signal from the photocell 120 is inverted into a positive signal by the amplifier 114. Similarly, the positive signal from the photocell 120 is able to trigger only the right stage of the flip-flop 122 since the amplifier 114 inverts the signal into a signal of negative amplitude.

It will be appreciated that a clipping circuit may be connected between the differentiator 116 and the left stage of the flip-flop 122 to clip negative signals and pass only positive signals to the flip-flop. It will also be appreciated

that a similar clipping circuit may be connected between the differentiator 119 and the right stage of the flip-flop 122. It will be further appreciated that the differentiator 119 may be replaced by a delay line (not shown) having its input terminal connected to the output terminal of the differentiator 116. The delay line would provide a delay corresponding to the time interval between the levels 130 and 132 in FIGURE 10.

Although this application has been disclosed and illustrated with reference to particular applications, the principles involved are susceptible of numerous other applications which will be apparent to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

What is claimed is:

1. In combination for determining the presence of a cap on the open mouth of a bottle containing liquid in the bottle to a particular level, means disposed relative to the bottle for directing light in a particular direction toward the bottle for diffusion of the light by the liquid through the mouth of the bottle, light-responsive means spaced from the bottle and displaced from the particular direction relative to the bottle and the light-directing means for receiving such diffused light, and control means responsive to the received light for producing signals having characteristics dependent upon such diffused light and upon the presence or absence of a cap on the mouth of a bottle.

2. The combination set forth in claim 1 in which means are included for eliminating any liquid foam from the space within the bottle above the particular level of the liquid in the bottle immediately prior to the direction of light through the mouth of the bottle.

3. The combination set forth in claim 1, including, means for providing a movement of the bottle, means responsive to the movement of the bottle for obtaining a signal from the light-responsive means only upon the passage of light through the mouth of the bottle to the control means in a particular position of the bottle and without obstruction by the rim of the bottle, and means disposed relative to the bottle during the movement of the bottle for eliminating any liquid foam from the space within the bottle above the particular level of the liquid in the bottle prior to the production of the signal by the energy-responsive means for passage to the control means.

4. In combination for determining the presence of a cap on the open mouth of a container holding liquid in the container to a particular level, means disposed relative to the container for directing light through the container at an oblique angle relative to the container and along a line passing through the mouth of the container for diffusion of such light through the liquid in the container, means disposed relative to the container for receiving the light diffused through the container from the directing means upon the absence of a cap on the mouth of the container, and means responsive to the received light for producing a signal upon the reception of such light and representing the absence of a cap on the container.

5. The combination set forth in claim 4 in which means are included for eliminating any liquid foam from the space within the container at positions above the particular level of the liquid in the container immediately prior to the direction of light through the mouth of the container.

6. In combination for determining the presence of a cap on the open mouth of a container holding liquid to a particular level, means for providing a movement of the container, a source of energy adjacent to the container and directed toward the container, energy-responsive means disposed relative to the source and the container at a position above the open mouth of the container for producing a signal having characteristics dependent upon the presence or absence of the cap on the bottle and for producing such signal upon the movement

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of the container to a particular position relative to the energy-responsive means, and means disposed relative to the container for directing an air stream through the mouth of the container to the space in the container above the particular level at a particular time before the movement of the container to the particular position relative to the energy-responsive means to prevent the foam in the bottle from affecting the signal produced by the energy-responsive means.

7. In combination for determining the presence of a cap on the open mouth of a container where the mouth is defined by a rim extending from the container and where the container is filled with a liquid to a particular level, means for providing a movement of the container, a source of energy disposed relative to the container to provide for a passage of the energy to the container in a particular direction to obtain a diffusion of such energy through the mouth of the container during the movement of the container, energy-responsive means disposed above the container at a position displaced from the particular direction relative to the source and the container to receive the energy passing through the mouth of the container and to produce a signal representative of such energy, and means disposed relative to the moving means for obtaining a passage of the signal from the energy-responsive means only during the diffusion of the energy through the mouth of the container during the time that the container is positioned to pass the energy without obstruction by the rim of the container.

8. In combination for determining the presence of a cap on the open mouth of a container where the mouth is defined by a rim extending from the container and where the container is filled with liquid to a particular level, a source of energy disposed to direct light in a particular direction toward the container energy, means for providing a movement of the container past the source of energy to provide for a diffusion of energy from the mouth of the container in a direction different from the particular direction in accordance with the disposition of the cap on the container, output means responsive to the energy passing from the mouth of the container for producing an electrical signal representative of such energy and having first characteristics representing the presence of the cap and having second characteristics representing the absence of the cap, and means responsive to the movement of the container relative to the source for obtaining the production of the signal by the output means only during the passage of energy through the mouth of the container without obstruction from the rim of the container.

9. In combination for determining the presence of a cap on the open mouth of a container filled with liquid to a particular level, means for providing a movement of the container, a source of energy disposed relative to the moving container for directing energy toward the container to obtain a diffusion of the energy through the mouth of the container, energy-responsive means disposed relative to the energy source and above the mouth of the moving container for producing signals at a particular position of the container relative to the energy-responsive means in accordance with the energy passing through the mouth of the container, and means disposed relative to the moving container for eliminating foam from the space within the container at positions above the particular level in the container immediately prior to the movement of the container to the particular position relative to the energy-responsive means.

10. In combination for determining the presence of a cap on the open mouth of a container where the mouth is defined by a rim extending from the container and where the container is filled with liquid to a particular level, first means for providing a movement of the container, second means disposed relative to the moving

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container for directing energy in a particular direction toward the container to obtain a diffusion of the energy through the mouth of the container in a direction different from the particular direction, third means disposed relative to the moving container for producing signals having characteristics dependent upon the energy passing through the mouth of the container, fourth means disposed relative to the moving container for providing for the passage of the signals from the third means only at an intermediate position of the container where the energy passing through the mouth of the container is not obstructed by the rim of the container, and means responsive to the characteristics of the signals from the third means at the intermediate position of the container as defined by the fourth means for indicating the presence or absence of a cap on the mouth of the bottle in accordance with the characteristics of the signal.

11. In combination for determining the presence of a cap on the open mouth of a container where the mouth is defined by a rim extending from the container and where the container is filled with liquid to a particular level, first means for providing a movement of the container, second means disposed relative to the container during the movement of the container for directing energy toward the container to obtain a diffusion of the energy through the mouth of the container, third means disposed relative to the container for producing signals defining the movements of the container for the diffusion of the energy through the second means from the second means without obstruction by the rim of the container, fourth means disposed relative to the container for receiving the energy diffused through the mouth of the container and for producing signals representative of such energy, fifth means operatively coupled to the third and fourth means for providing for the passage of the signals from the fourth means during the operation of the third means in defining the movements of the container without the obstruction of the rim of the container to the diffusion of energy through the mouth of the container, and sixth means operatively coupled to the fourth and fifth means for providing an indication of the disposition or lack of disposition of a cap on the container in accordance with the characteristics of the signals from the fourth means during the operation of the fifth means.

12. The combination set forth in claim 10, including, means for removing foam from the space within the mouth of the container at positions above the particular level in the container and before the intermediate position in the direction of movement of the container to facilitate the diffusion of liquid through the mouth of the container.

13. The combination set forth in claim 11, including, means disposed above the container for directing air into the mouth of the container at positions above the particular level on the container at positions before the operation of the second and third means in indicating the presence of caps to facilitate the diffusion of the liquid through the mouth of the container.

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