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Fry et al.

[11] **3,887,285**

[45] **June 3, 1975**

[54] **FLASK INSPECTION**

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[73] Assignee: **Owens-Illinois, Inc.,** Toledo, Ohio

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[52] **U.S. Cl.**............ **356/240;** 209/111.7; 250/223 B

[51] **Int. Cl.**........................ **G01n 21/16;** G01n 21/32

[58] **Field of Search**.................... 356/237, 239, 240; 250/223 B; 209/111.7

[56] **References Cited**

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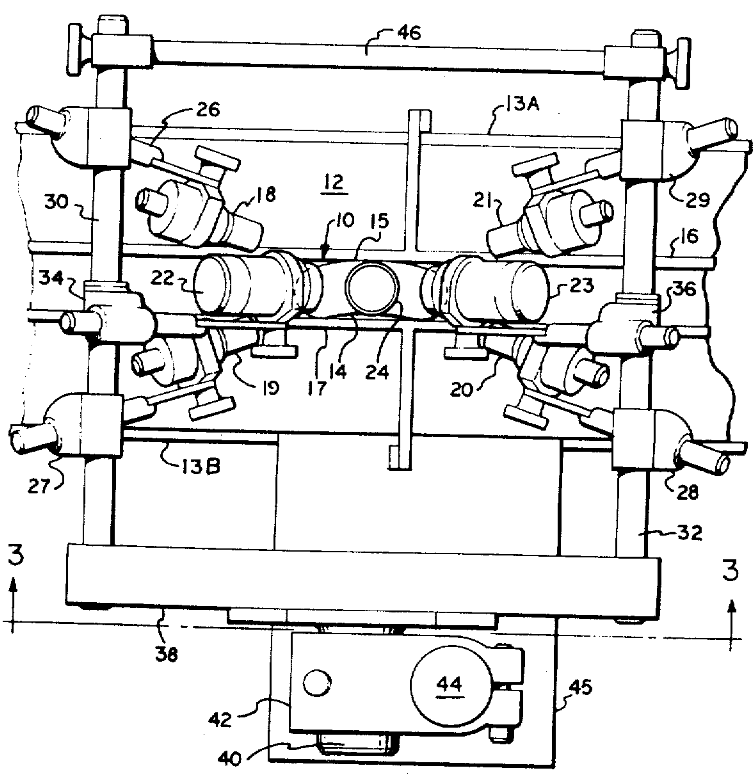
Attorney, Agent, or Firm—Steve M. McLary; E. J. Holler

[57] **ABSTRACT**

Apparatus and method for inspecting the junction of the neck and shoulder portions of a flask-type glass container for the presence of checks in the junction. The transverse dimension of the junction of the neck and shoulder portions of a glass flask is illuminated, on both sides of the neck, by light sources above the flask which shine through the neck and focus an image of their filament on the junction area opposite their location relative to the neck. Light responsive units sense any reflection from checks in the illuminated area. A signal generation unit then generates a signal in response to a sensed reflection, and this signal may be used to reject any glass container causing such a signal to be generated.

8 Claims, 4 Drawing Figures



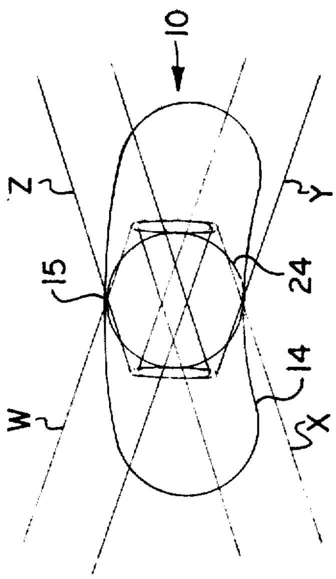

10
Z
Y
15
24
14
W
X

FIG. 2

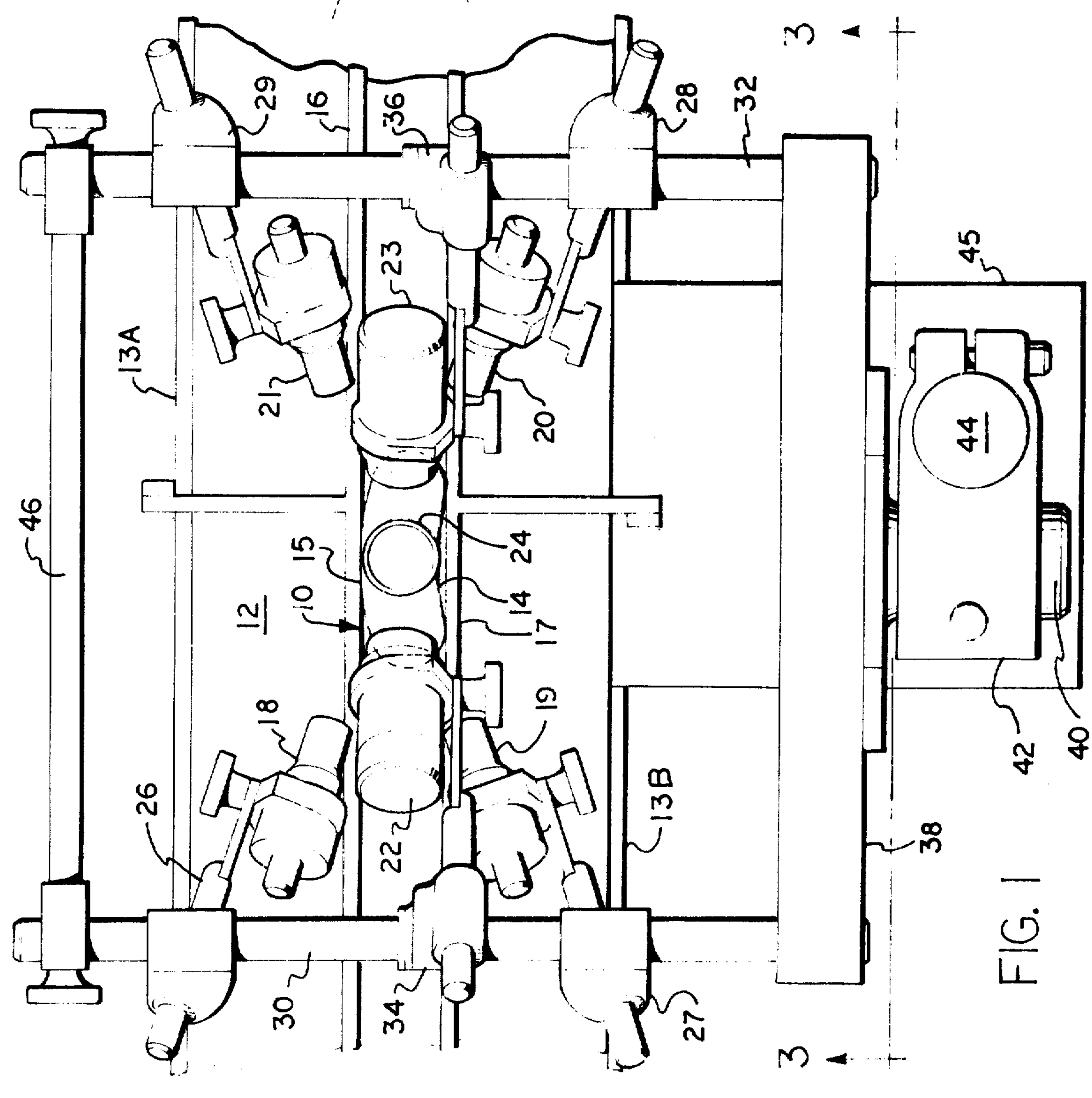

3
3
46
29
16
36
28
32
23
13A
21
20
45
44
24
15
12
10
14
17
18
19
42
40
26
22
13B
38
30
34
27

FIG. 1

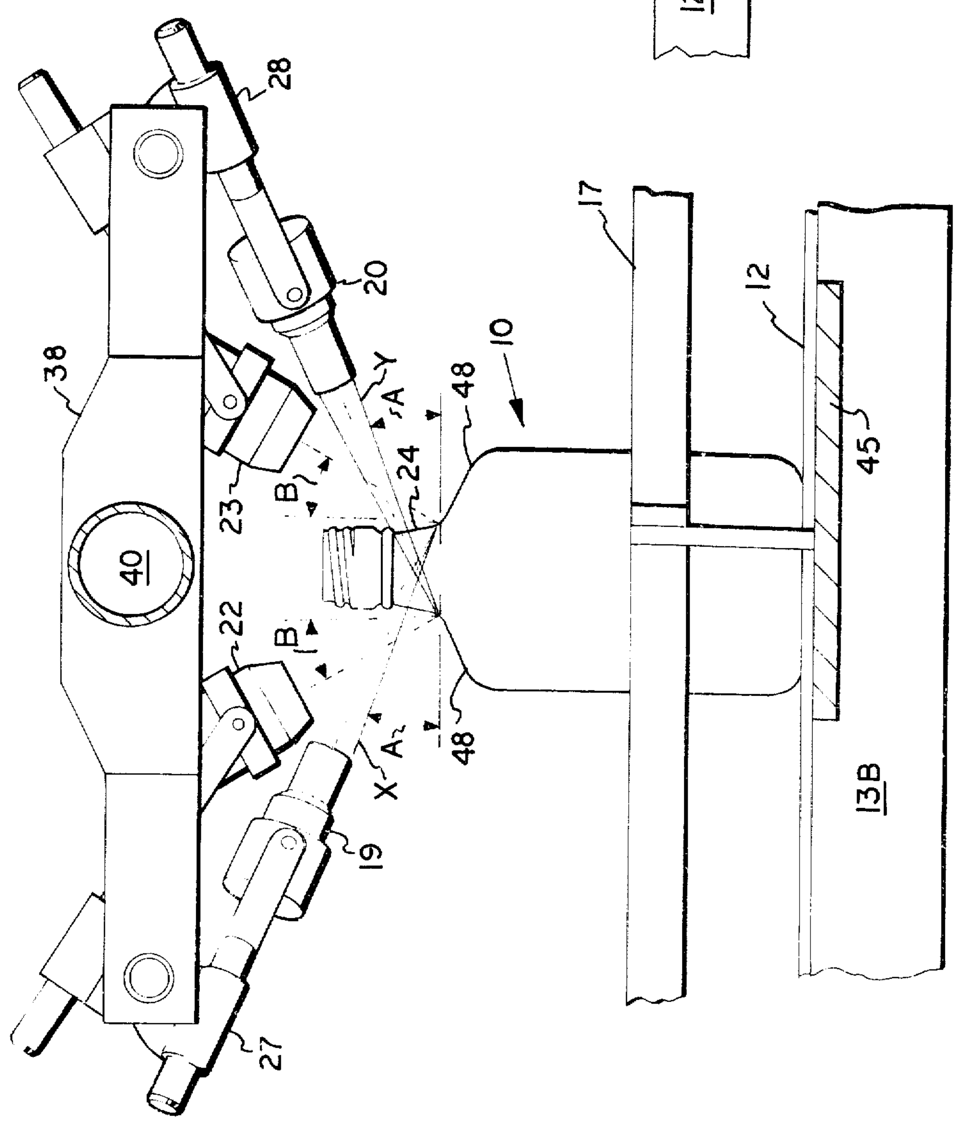

10
12
13B
17
19
20
22
23
24
27
28
38
40
45
48
X
Y
A
B

FIG. 3

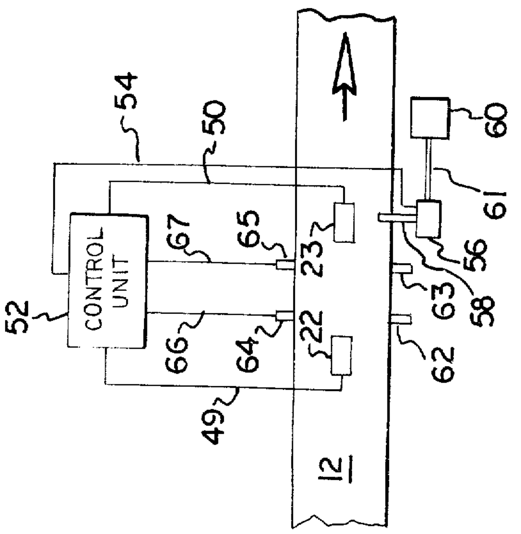

CONTROL UNIT
12
22
23
49
50
52
54
56
58
60
61
62
63
64
65
66
67

FIG. 4

FLASK INSPECTION

BACKGROUND OF THE INVENTION

This invention generally relates to the inspection of glass containers for defects known as checks. More particularly, this invention relates to the inspection of flask-type glass containers for the presence of checks at the junction between the neck and shoulder portions thereof. Specifically, this invention relates to inspection of flask-type glass containers by illumination of the junction between the neck and shoulder portions thereof only along the transverse dimension thereof.

The use of optical inspection techniques to find small cracks or checks in glass containers is known in the art. Most of these techniques require that the container be rotated or that the optical system be rotated. Such techniques are not well suited to asymmetric containers such as flasks which have a concave and a convex side. Experience has shown that the majority of checks in flasks occur at the junction between the neck and shoulder portions and lie along the transverse dimension of the flask. We have used this knowledge to devise an inspection device for flasks which can inspect the base of the neck area for checks while the flasks are moving and without rotation of either the flask or the optical inspection equipment.

SUMMARY OF THE INVENTION

Our invention is an apparatus and method for the inspection of glass containers having an elongated neck portion merging with a shoulder portion and also having an elongated longitudinal dimension with respect to its transverse dimension. The apparatus includes a means for transporting the containers in single file and in an upright position to and through an inspection zone along a fixed centerline of travel; a means positioned in the inspection zone, for illuminating the junction of the neck and shoulder portions along the transverse dimension only of the glass container; a light responsive means for sensing reflections from defects which occur at the illuminated junction; and a signal generating means for generating a signal in response to reflection sensed by the light responsive means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of the apparatus of the present invention;

FIG. 2 is a top plan view of the illumination of a flask-type glass container provided by the apparatus of FIG. 1;

FIG. 3 is a cross-sectional side elevation view of the apparatus of FIG. 1 taken along the line 3—3 in FIG. 1; and

FIG. 4 is a schematic diagram of the control system of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In FIG. 1, glass containers **10** are moved from left to right on an endless, moving belt-type conveyor **12**. The conveyor **12** is supported by side frame members **13A** and **13B**. The glass container **10** is of the type which is generally known as a flask, and has a generally elliptically shaped main body as viewed in cross-section which has an elongated longitudinal axis as compared to its transverse axis. In FIG. **1**, the glass containers **10** are moving with their longitudinal axis generally parallel to their path of travel. It may also be noted in FIG.

1 that the glass containers **10** have a concave side **14** and a convex side **15**. Parallel guide rails **16** and **17** engage the glass container **10** and constrain it to movement along a fixed centerline. It should be noted that proper operation of this apparatus is not dependent upon the concave side **14** facing one particular side of the conveyor **12**. That is, the guide rails **16** and **17** will engage either the concave or the convex side for proper guiding of the glass container **10** along the fixed centerline. The conveyor **12** and the guide rails **16** and **17** generally serve as a means for transporting the glass containers **10** in a single file and in an upright position to and through an inspection zone along a fixed centerline of travel. The inspection zone itself may generally be defined as that area in which the glass container **10** is illuminated by one or more of four discrete light sources **18** through **21**. The light sources **18** through **21** are preferably of the type which have a filament-type light bulb contained within them and a lens system to allow focusing of the image of the filament of the light bulb. Electrical power connections to the light sources **18** through **21** are not shown, since one skilled in the art will realize that a power source is necessary to provide the illumination. This may be either an AC or a DC power source dependent upon the requirements or availability of a particular power source. It will be noted that the light sources **18** through **21** are located in pairs adjacent to the leading and trailing edges of the glass container **10** on either side of the centerline of the path of travel of the glass container **10.** Also positioned generally along the centerline of the path of travel of the glass container **10** are two opposed light sensitive pickups or photocells **22** and **23**. The light pickups **22** and **23** are light responsive means which are used to sense any reflection from the glass container **10** as a result of the illumination of defects in the glass container **10** from the light sources **18** through **21.** It is well known in the art that defects in glass containers known as checks, which are small flaws or cracks in the glass containers, are readily detected by shining light onto the area of the defect and then sensing any reflection from that area. If the glass container is perfect in the area which is illuminated, no reflection results and consequently the container is assumed to be perfectly formed. In the case of the glass containers **10** of the flask shape, conventional inspection equipment has proven unable to inspect these glass containers in this manner. The precise illumination technique used is best seen with reference to FIG. **2**, but in general terms a light source, for example the light source **18**, is directed downwardly such that the beam from the light source **18** shines completely through an upstanding neck portion **24** of the glass container **10** and illuminates a portion of the shoulder of the glass container **10** on the opposite side of the centerline of the path of travel of the glass container **10** from the location of the light source **18.** All the light sources **18** through **21** are positioned to direct their beams in such a manner that the beams go through the neck portion **24** and illuminate a portion of the glass container shoulder on the opposite side of the centerline of the path of travel of the glass container **10** from the location of the light source. The light sources **18** through **21** are adjustably supported by individual clamps **26** through **29** respectively. The clamps **26** and **27** are attached to a support rod **30** and the clamps **28** and **29** are attached to a second support rod **32.** The light sensitive pickup **22** is

supported from a substantially identical clamp 34 which is attached to the support rod 30. Similarly, the light pickup 23 is supported by a clamp 36 which is attached to the support rod 32. The support rods 32 and 34 are held apart at a fixed distance by a cross bar 38. The cross bar 38 in turn is attached through a relatively large pin 40 to an array holder 42. The array holder 42 is itself supported by a vertically extending rod 44 which is attached to a plate 45 carried by the frame member 13B of the conveyor 12. A cross rod 46 directly opposite the cross bar 38 completes the sides of a substantially rectangular structure which allows the light sources 18 through 21 and the light pickups 22 and 23 to be held in a fixed location in a stable position and generally defines what may be considered to be an inspection zone. As glass containers 10 move into the area in which they will be illuminated by any one of the light sources 18 through 21, the light sensitive pickups 22 and 23 can begin to receive any light which is reflected from the glass container 10. It is preferable that the light sensing be done only when the glass container 10 is in the location shown in FIG. 1; that is, when the base portion of the container neck 24 is illuminated by all four light sources 18 through 21. This apparatus will work if the sensing is done continuously as the glass container 10 moves through the entire inspection zone, but the possibility of stray reflections does exist if this particular mode of operation is chosen. As will be shown with respect to FIG. 4, the total inspection logic circuit includes photocells which allow a reflection to be accepted only when the glass container 10 is in the position shown in FIG. 1.

FIG. 2 illustrates the illumination technique used. A light beam W from the light source 18 shines through the neck 24 of the glass container 10 and is positioned and focused such that an image of the filament of the light source 18 is focused on the base of the neck 24. A light beam X from the light source 19 also shines through the neck 24 and forms a focused image of the filament of the light source 19 in a plane at the base of the neck 24. The beams W and X overlap somewhat in their coverage to ensure complete illumination of substantially the entire transverse dimension of the base of the neck 24. Light beams Y and Z from the light sources 20 and 21 respectively are positioned and focused to illuminate the opposite side of the base of the neck 24 in an identical manner. It is possible to achieve this illumination pattern using only two light sources, but the length of the area to be illuminated is usually such that at least two separate, overlapping light sources are necessary for complete coverage. Under such conditions, it would be possible to have both light sources on the same side of the centerline of the path of travel of the glass container 10, but still positioned with one adjacent the leading edge and the other adjacent the trailing edge of the glass container 10.

With reference now to FIG. 3, the light sources 19 and 20 and the light sensitive pickups 22 and 23 may be seen in their positions above the glass container 10. The glass container 10 itself has a relatively elongated vertically extending neck portion 24, as previously noted, which smoothly merges with a shoulder portion 48. It is at the junction between the neck portion 24 and the shoulder portion 48 that checks are most likely to occur in this particular type of glass container. In addition, the location of the checks, as determined from experience, is almost always along the transverse dimension of the glass container 10. As previously noted in FIG. 2, this dimension is the shorter of the longitudinal and transverse dimensions of this particular shape of glass container 10. It is also readily apparent that the light sources 18 through 21 and the light sensitive pickups 22 and 23 are generally pointed downwardly at the neck 24 of the glass container. The beam X from the light source 19 and the beam Y from the light source 20 may be seen as passing through the neck 24 of the glass container and illuminating the opposite shoulder portion 48 of the glass container 10. This particular illumination configuration was previously explained and clearly shown with respect to FIG. 2. The angle at which the beams from the light sources 18 through 21 strike the glass container 10 is designated as the angle A and may range from 20 to 45 degrees. However, an angle of 25 degrees is preferred. Likewise, the light sensitive pickups 22 and 23 are positioned at an angle B with respect to vertical to receive reflections from defects which are present at the plane of illumination of the shoulder of the glass container 10. The angle B may be between 20° and 45° and is preferably 25°.

In FIG. 4, a schematic circuit diagram of the control system for the inspection apparatus is shown. The supporting members and the glass container itself have been eliminated for the purposes of clarity of understanding. As shown, the two light sensitive pickups 22 and 23 are positioned above the conveyor 12. Electrical wires 49 and 50 connect the light sensitive pickups 22 and 23 to a control unit or signal generation means 52. The control unit 52 is of the type well known in the art which will generate an output signal, in this case transmitted along an output wire 54, in the event it receives a signal from either the light sensitive pickup 22 or the light sensitive pickup 23. In the event the control unit does generate an output signal along the output wire 54, it is assumed that a defect has occurred in the glass container 10 which would warrant the rejection of this particular glass container. The output signal on the wire 54 is transmitted to a solenoid operated valve 56 which is normally closed. This signal opens the solenoid valve 56 and allows a blast of compressed air to exit through a nozzle 58 connected to the solenoid valve 56. The nozzle 58 is positioned along the conveyor 12 at a location which will reject any glass container 10 which passes in front of it so long as the solenoid valve 56 is on. Compressed air is furnished to the solenoid valve 56 from a source of compressed air 60 along a pipeline 61. The solenoid valve 56 and nozzle 58 simply illustrate one type of rejection means which is operative in response to the signal from the control unit 52 to reject any glass container which causes generation of a signal by the control unit 52. Other types of rejection means, such as direct operating electrical solenoids which could knock the glass container 10 off of the conveyor 12 may also be used. In order to ensure that the glass container 10 is in an optimum location for illumination of the shoulder portion 48 for inspection of checks, as previously explained, the control unit 52 is made inoperative or unresponsive to signals from the light sensitive pickups 22 and 23 except in one particular location. To perform this function, two light sources 62 and 63 are spaced apart on one side of the conveyor 12 and are pointed to shine across the conveyor 12. Corresponding photocell pickups 64 and 65 are positioned on the opposite side of the conveyor 12 to receive light from the light sources 62 and 63. The photocells 64 and

65 are connected to the control unit 52 by suitable electrical wiring 66 and 67. So long as either the photocell 64 or the photocell 65 is receiving light from its associated light sources 62 or 63, the control unit 52 is unresponsive to light signals received by the light sensitive pickups 22 or 23. It is only when the glass container 10 is in a position to block both of the light sources 62 and 63 that the control unit 52 is activated and will generate a signal in response to any light received by either the light sensitive pickup 22 or the light sensitive pickup 23. The relative position of the light sources 62 and 63 and photocells 64 and 65 are set such that this occurs only when the glass container 10 is in the position shown in FIG. 1. In a normal setup of this system, the light sources 62 and 63 and photocells 64 and 65 are spaced apart a distance which corresponds to the longitudinal dimension of the glass container 10.

We claim:

1. Apparatus for inspecting glass containers, said glass containers having an elongated neck portion which merges with a shoulder portion and a generally elliptical main body cross section with an elongated longitudinal dimension with respect to the transverse dimension, which comprises, in combination:

means for transporting said glass containers in single file and in an upright position to and through an inspection zone along a fixed centerline of travel;

means, positioned in said inspection zone, for illuminating the junction of said neck and shoulder portions along the transverse dimension only of said glass containers;

light responsive means for sensing reflection from defects occurring at said illuminated junction; and

signal generating means for generating a signal in response to reflection sensed by said light responsive means.

2. The apparatus of claim 1 further including:

rejection means, operative in response to said signal from said signal generating means, for rejecting any glass container causing generation of said signal by said signal generating means.

3. The apparatus of claim 1 further including:

means, responsive to the presence of a glass container in said inspection zone, for activating said signal generating means to accept an input from said light responsive means only when said glass container is in a known position in said inspection zone.

4. The apparatus of claim 1 wherein said means for illuminating the junction of the neck and shoulder portions of said glass containers along the transverse dimension only thereof includes:

a plurality of focused light sources, at least one of said light sources being positioned adjacent the leading edge of said glass containers and at least another one of said light sources being positioned adjacent the trailing edge of said glass containers; and

means for supporting said light sources above said glass containers with the direction of beams from said light sources being downward at an angle of between 20° and 45° with respect to horizontal and with the path of travel of said beams being through the neck portion of said glass containers to a focal plane along the shoulder portion of said glass containers.

5. The apparatus of claim 1 wherein said light responsive means includes:

at least two photocells, positioned substantially along the centerline of the path of travel of said glass containers and spaced apart a distance greater than the diameter of the neck portion of said glass container and less than the longitudinal dimension of said glass container; and

means for supporting said photocells above said glass containers with the field of view of said photocells being downward toward said illuminated junction at an angle of between twenty and forty-five degrees with respect to vertical.

6. A method for inspecting glass containers for the presence of checks, said glass containers having an elongated neck portion which merges with a shoulder portion and a generally elliptical main body cross section with an elongated longitudinal dimension with respect to the transverse dimension, the method comprising the steps of:

presenting said glass containers one at a time in an inspection zone;

illuminating the junction of said neck and shoulder portions along the transverse dimension only thereof in said inspection zone;

sensing reflection from defects occurring at said illuminated junction; and

generating a signal in response to any reflection sensed from said illuminated junction.

7. The method of claim 6 which further includes the step of:

rejecting any glass container causing generation of said signal in response to generation of said signal.

8. The method of claim 6 which further includes the step of:

preventing generation of said signal in response to said reflection except when said container is in a known position in said inspection zone.

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