United States Patent

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[54] AUTOMATIC INSPECTION MACHINE

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[21] Appl. No.: **34,113**

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[52] **U.S. Cl.** ..... **209/75,** 209/111.7, 250/223 B, 356/240

[51] **Int. Cl.** **B07c 5/342**

[58] **Field of Search** ..... 209/111.7, 75; 250/223 B; 356/240

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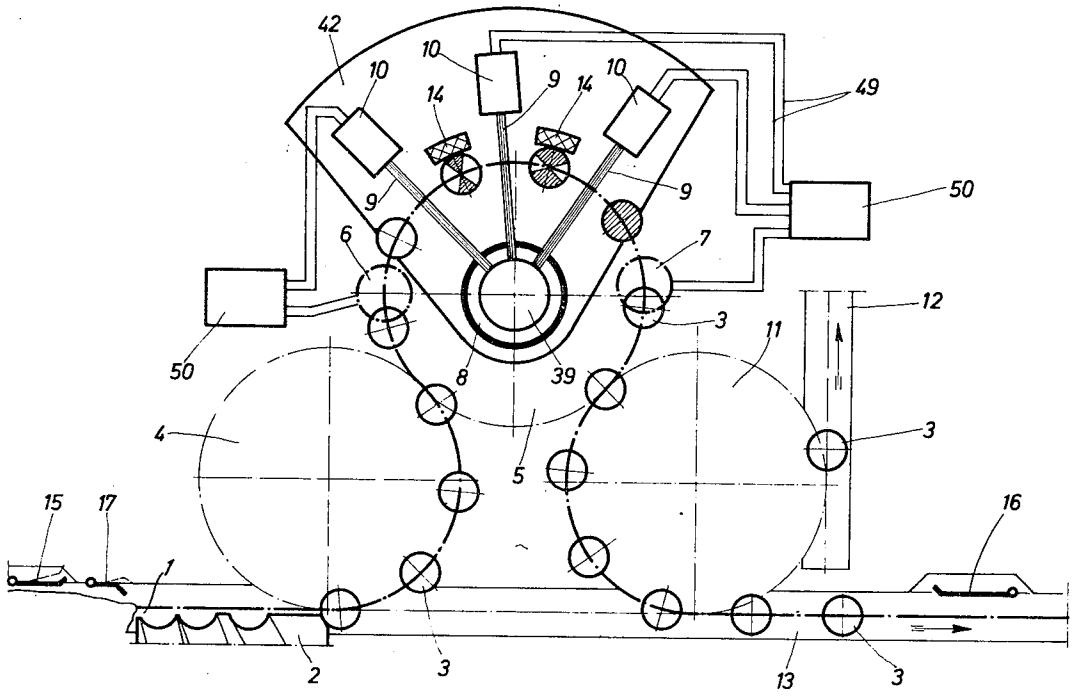
[57] **ABSTRACT**

Apparatus for inspecting empty transparent containers for dirt. The containers are transferred from an inspection star wheel rotor to a separating star wheel rotor. There are separate inspection sensors associated with the inspection rotor for respectively inspecting the side wall, bottom and top lip of the containers. A common dirty bottle segregating mechanism is associated with the separating star wheel rotor and a common regulating unit which responds to the several inspection sensors for selectively actuating the segregating mechanism to segregate dirty from clean containers on the separating rotor. The clean containers leave the separating rotor via a discharge conveyor, and the dirty bottles leave the separating rotor via a reject conveyor.

13 Claims, 13 Drawing Figures



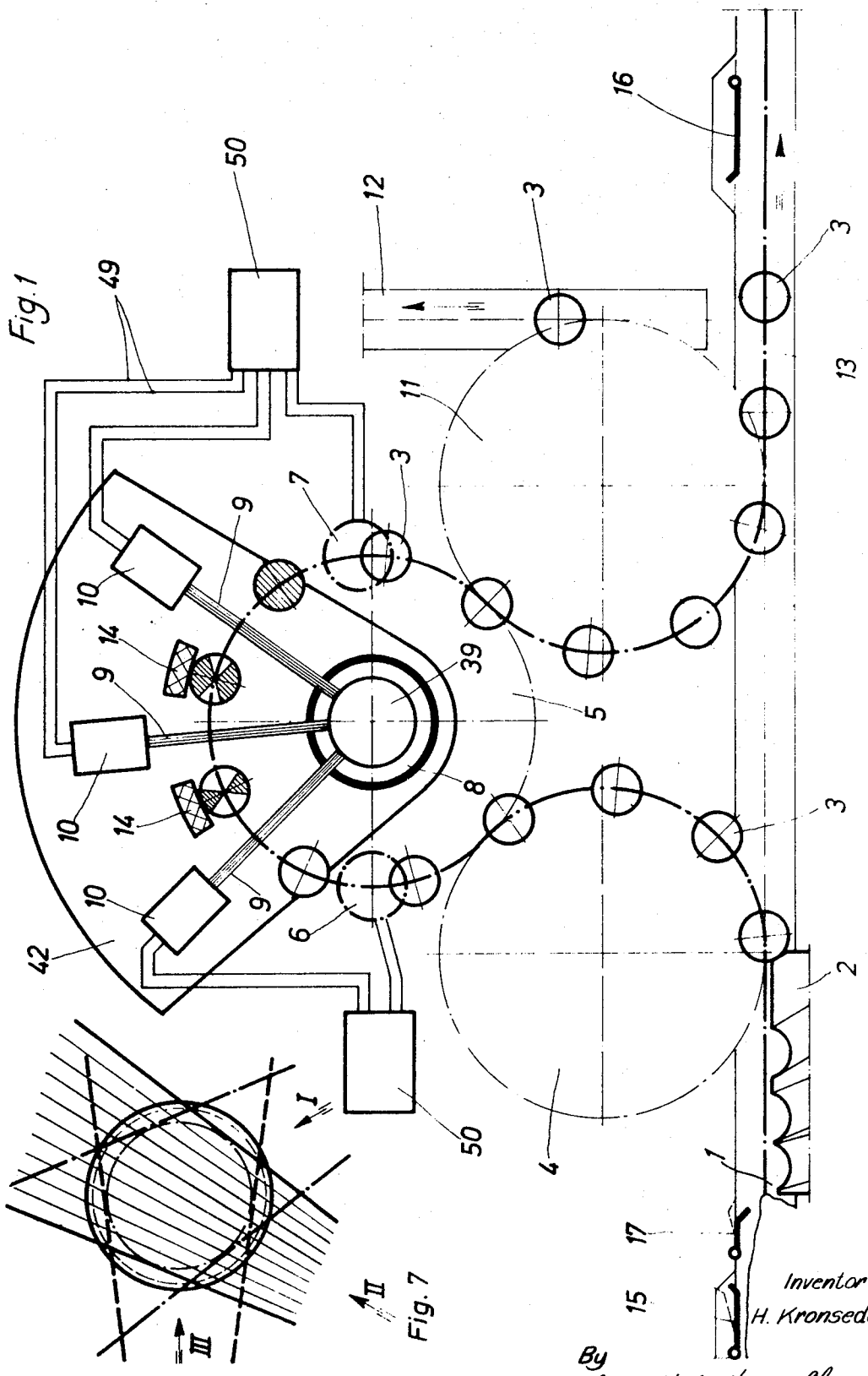


Fig. 7

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Fig. 1a

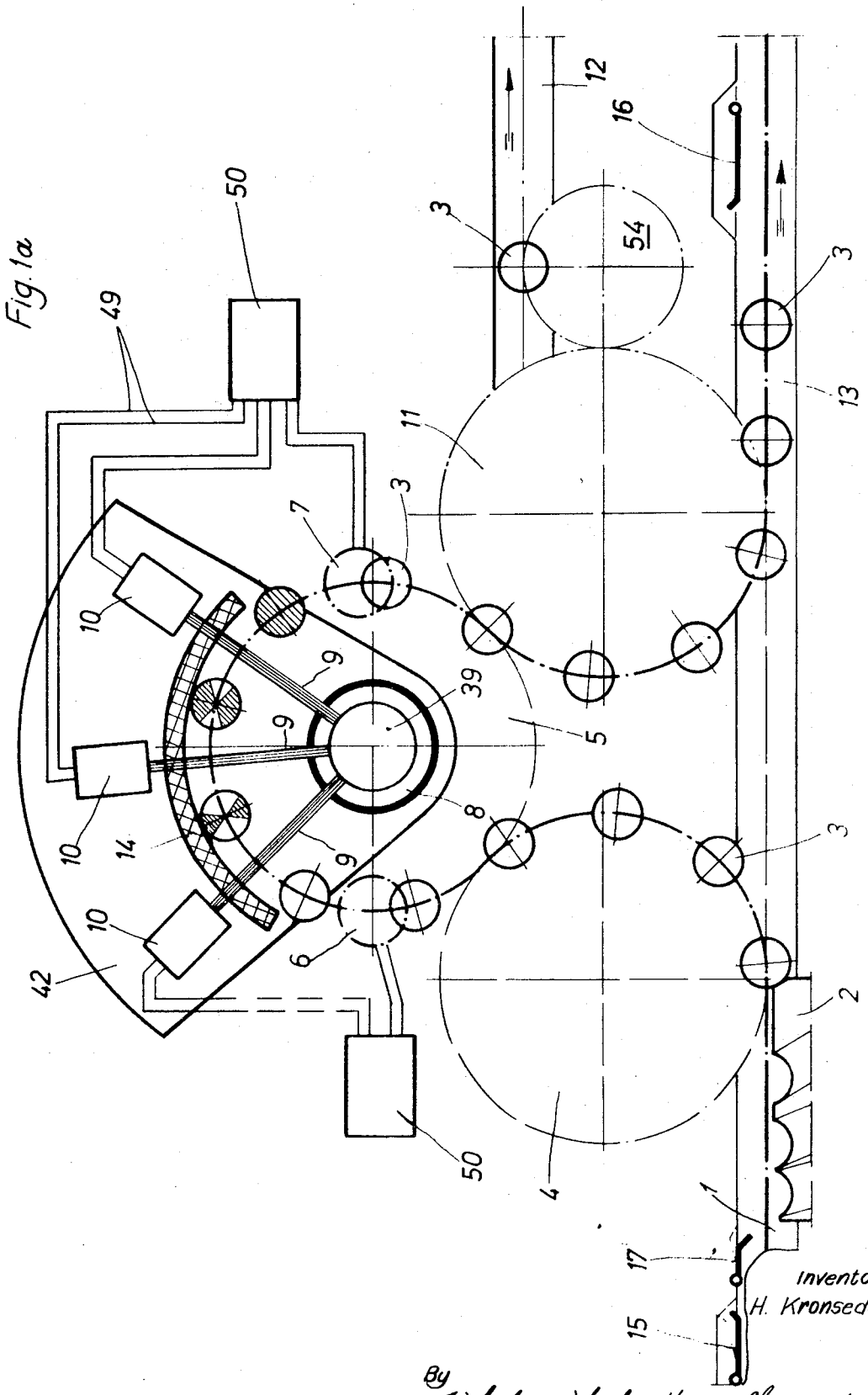

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Fig. 2

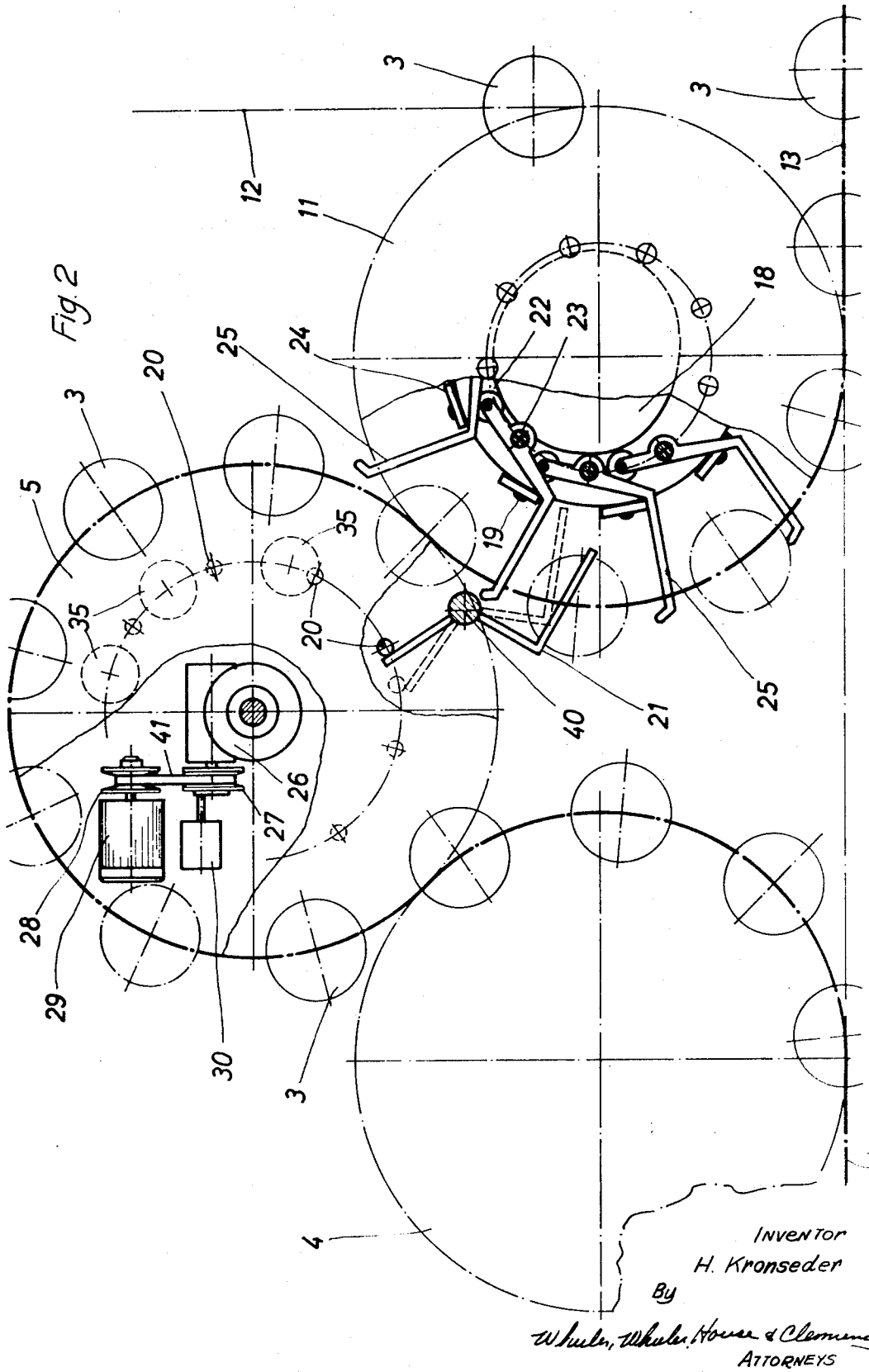

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Fig. 3

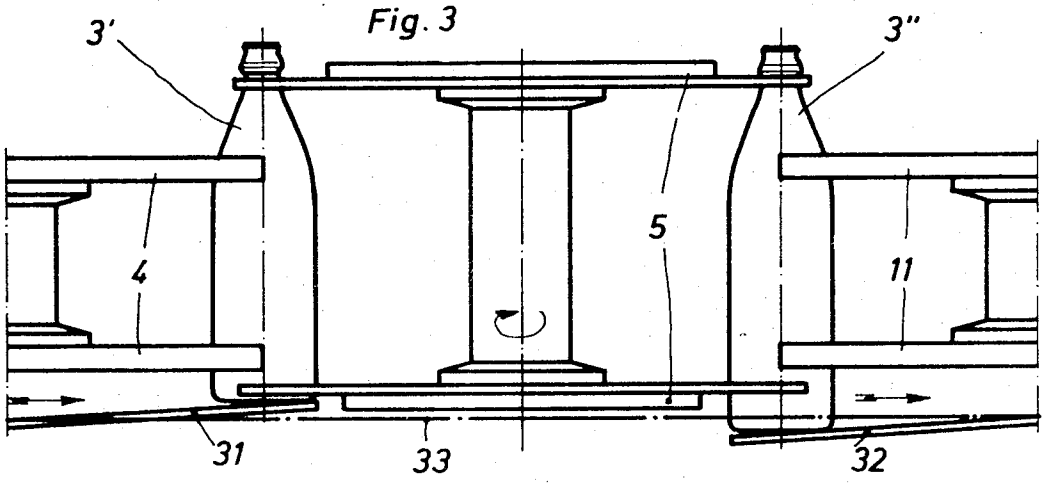
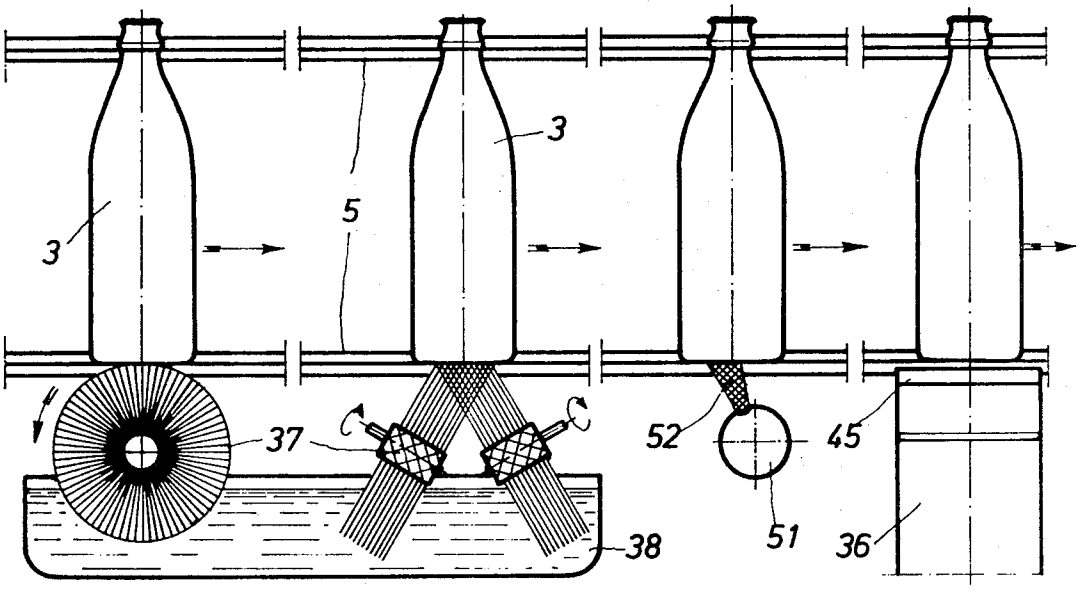


Fig. 4



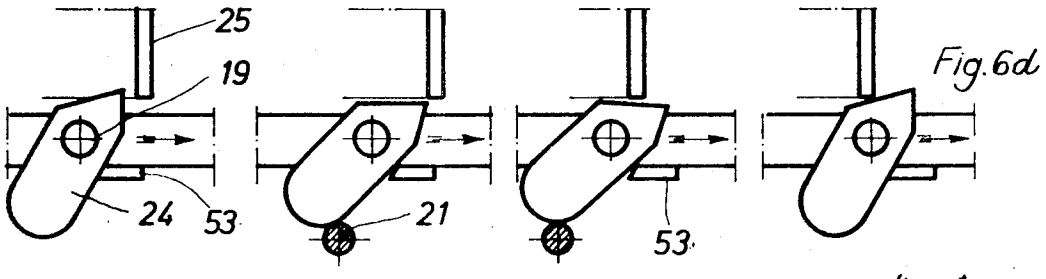


Fig. 6a Fig. 6b Fig. 6c Fig. 6d

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Fig. 8

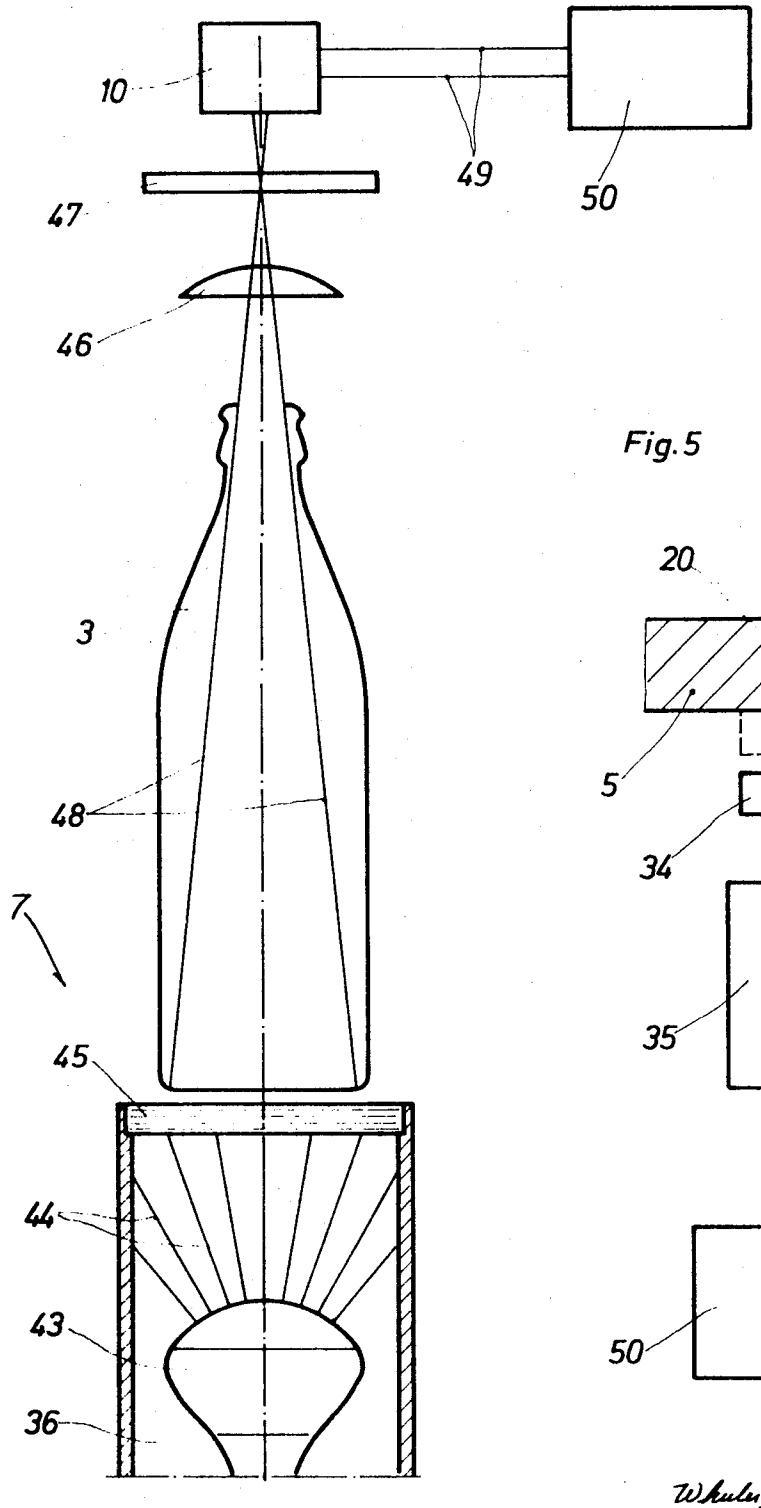

Fig. 5

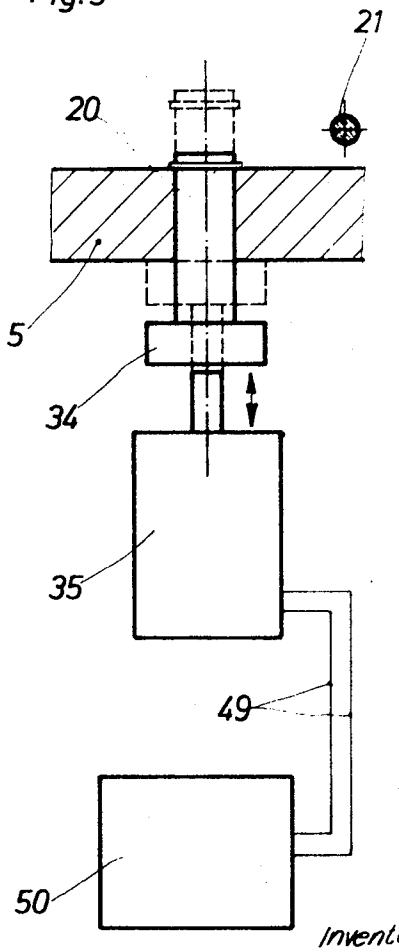

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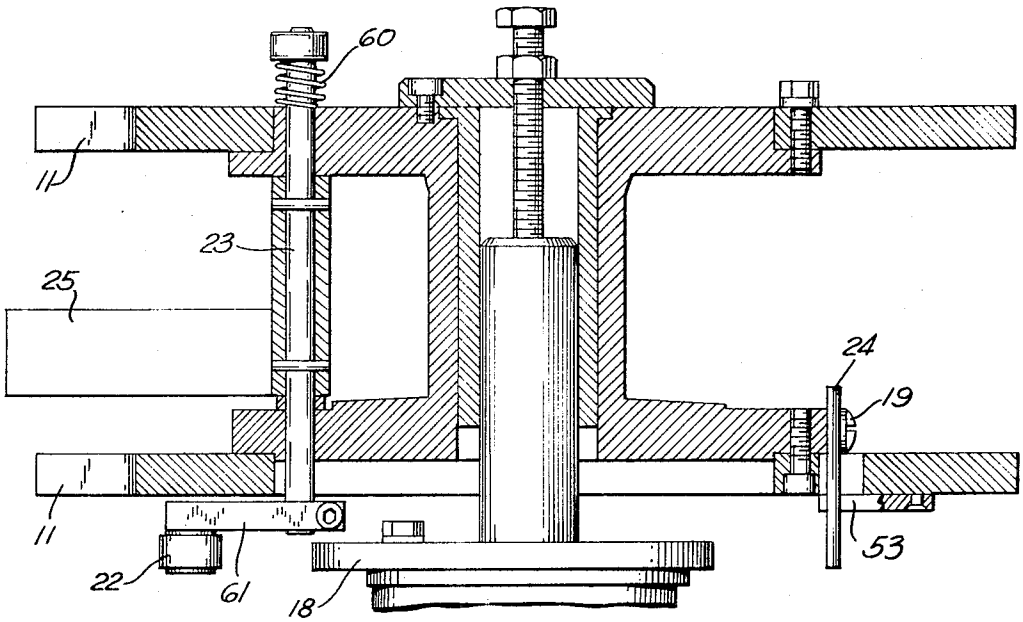
Fig. 9



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AUTOMATIC INSPECTION MACHINE

CROSS REFERENCE TO RELATED APPLICATION

Cross reference is made to my copending U.S. Pat. application Ser. No. 846,077, filed July 30, 1969, now U.S. Pat. No. 3,607,547 granted Sept. 21, 1971, which shows speed control mechanism also incorporated in the apparatus of this invention.

This invention relates to apparatus for inspecting empty, open top, transparent containers such as bottles, glasses and so on, which are transferred in upright position by means of bottle transport starwheels.

BACKGROUND OF THE INVENTION

Apparatus is known for inspecting only the interior side wall surface of such containers for dirt. In certain such known apparatus, an inspection head is introduced into each bottle. The head spirally scans the surface of the bottle walls by means of ultraviolet light. The construction costs for this inspection machine are excessive, and the apparatus is very limited in its output. Moreover, these machines do not inspect the bottom of the bottle, where most of the dirt is located.

There are also known inspection machines which inspect only the bottom of the bottle. The bottles held by suction cups traverse a base scanner. Labels attached on the exterior wall or dirt on the interior wall of the bottle are not detected. Accordingly, personnel are still needed to inspect the bottles visually.

Moreover, machines of the type described typically do not have their own drive. Accordingly, they only work if sufficient pressure is delivered thereto from the conveyor belt. The bottle starwheels of such machines must be driven by the bottles. Accordingly, the speed of the machine varies, and this adversely affects all the following machines in the plant.

There are also known rotating inspection machines fitted out with a bottle base scanner in an infeed star wheel and a bottle wall scanner in the region of a central star wheel. In these machines there is a scanning system for the base which oscillates according to the bottle supply. The scanning system is located in the region of the infeed star wheel. The electronics needed for this base inspection system is very expensive, as every impulse received to signal the ultimate elimination of a dirty bottle must be stored until the dirty bottle reaches a right station. Furthermore, each bottle must be rotated during the inspection of the bottle wall, this further complicating the construction. Moreover, the machine is slow and limited in its output because of the time cycle required by the oscillating scanning system and the bottle rotating mechanism.

The removal of foam from the bottom of the bottle is a troublesome and not adequately solved problem associated with all known inspection machines. In the case of the last-mentioned machine, the inspecting apparatus for the bottom of the bottle is arranged in the infeed star wheel This is quite near the conveyor belt which delivers the bottles. Foam at the bottom of the bottle is blown off, but this cannot be accomplished reliably in the short passage of the bottle from the conveyor belt to the base scanner. Accordingly, these machines often deliver bottles having some foam on their bottoms.

SUMMARY OF THE INVENTION

According to the present invention, at least two separate inspecting scanners, for example, one for the bottom and another for the wall of the bottles, are arranged in the bottle passageway in the region of the central inspection star wheel rotor. These separate scanners trigger a common bottle reject apparatus. In addition, a third conventional inspecting scanner may be arranged at the top side of the lip of the bottle mouth in the region of the central inspection star wheel to inspect this portion of the bottle and trigger the reject mechanism.

Other features of the invention include location of the base scanner for the bottom of the bottle at the end of the passageway of the central inspection star wheel. Also, apparatus for removing foam at the bottom of the bottle is located between the infeed of the bottle and the base scanner. The foam removing apparatus desirably comprises brushes rotating in a water bath and against the bottom of the bottle.

Another feature of the invention consists in the fact that the wall scanning apparatus includes at least two radial pencils of light rays coming from a stationarily arranged light source crossing the bottle path. As the bottles traverse their path, rotating devices are arranged for partially turning the bottles so that the bottle wall sections intercepted by the different light beams overlap. This insures scanning of the entire area of the bottle wall. Only one light source located in the middle of the region of the central star wheel is needed for the wall scanner operation. The receivers for the light beams are advantageously located outside the bottle path.

Another feature of the invention relates to the regulating unit by which all dirt scanners actuate through a common reject mechanism selected bottle holders (holding and releasing arms) which segregate dirty from clean bottles on the separating or output star wheel rotor. The scanners selectively trigger an amplifier which energizes an electromagnet which lifts a reject cam which, in turn, actuates mechanism which positions appropriate bottle holders in holding or non-holding position. When in holding position, the holder directs the dirty bottle to a reject conveyor. When the bottle is clean, the reject cam is not activated. Accordingly, the holding and releasing arm corresponding to such clean bottles is not selected, whereupon such bottles are delivered by the output star wheel to the normal output conveyor of the machine.

Another feature of the invention relates to slide ramps which contact the bottoms of the bottles between successive star wheels, The ramps provide an adjustment for accommodating for varying sizes of the bottles. The ramps raise short bottles and lower tall bottles so that all bottles, regardless of height, fit the machine.

Another feature of the invention relates to a variable speed drive for the machine. A bottle sensor signals a device which controls the speed of the machine. In case of missing bottles or stagnation of the bottles, the bottle infeed is blocked and the speed of the machine is reduced to a minimum.

The present machine provides a novel and compact arrangement of a variety of inspection devices around the central star wheel. Each device independently signals a simple, inexpensive, mechanical reject device which mechanically stores and transmits the separate reject signals. The mechanism of the machine is easily understood and repaired by the machine operators.

The wall inspection device of the present invention further has the great advantage in that the bottles need not be rotated by separate mechanism for each bottle as they pass the wall inspection zone. The bottles need only be partially turned as they travel on their path. This is accomplished simply by pressing them laterally against friction rails. Thus, problems of bottle transport and bottle rotation are solved by simple and inexpensive machine elements.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view of an automatic inspection machine embodying the invention, certain electrical connectors being also shown schematically.

FIG. 1*a* is a diagrammatic view similar to FIG. 1, but showing a modified embodiment.

FIG. 2 is another diagrammatic plan view of the machine of FIG. 1, showing certain parts not shown in FIG. 1 and omitting certain parts which are shown in FIG. 1.

FIG. 3 is a diagrammatic side view of a portion of the device of FIG. 1, and showing the ramps for varying size bottles to fit into the machine.

FIG. 4 is a diagrammatic developed elevation of the inspection star wheel rotor illustrating an arrangement of the cleaning elements for the removal of foam from the bottom of the bottle.

FIG. 5 is a fragmentary view partly in cross section and including elements shown diagrammatically of the mechanism for triggering the reject mechanism.

FIGS. 6*a* to 6*d* are fragmentary side elevations of the segregating star wheel illustrating various stages in the actuation of the holding dogs by the actuating arm.

FIG. 7 is a diagrammatic view which illustrates the overlap of the light beams over various parts of the bottle.

FIG. 8 is a diagrammatic side view of the scanner for inspecting the bottoms of the bottles.

FIG. 9 is a vertical cross section through the separating star wheel rotor of a machine embodying the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Although the disclosure hereof is detailed and exact to enable those skilled in the art to practice the invention, the physical embodiments herein disclosed merely exemplify the invention which may be embodied in other specific structure. The scope of the invention is defined in the claims appended hereto.

The bottles **3** leaving a washing machine are transferred by means of the infeed conveyor belt **1** into the operating region of the inspection machine. The bottles **3** are transferred by the infeed screw or worm **2**, as shown in FIG. **1**, to the infeed star wheel rotor **4**, which transfers the bottles to the central inspection star wheel rotor **5**. Just after the bottles **3** enter the inspection star wheel rotor **5**, they pass the zone of a top lip or mouth inspection scanner **6**. Thereafter, the bottles **3** are subject to a side wall scanner **42** and pass successively through three light beams **9** coming from a common light source **39** which is stationarily arranged in the central light well **8** of the wall inspection or scanning device. The beams **9** are respectively aimed at light sensitive receivers **10** at the periphery of the inspection rotor **5**. The receivers **10** are connected with appropriate electric amplifiers **50** via circuit lines. In FIG. **1** there are short friction pads or rails **14** intermediate the successive light beams **9**. The bottles **3** are pressed laterally against pads **14**, thus to effectuate intermittently a partial rotation of the bottle about its upright axis. This arrangement insures that all portions of the side wall of the bottle will surely be scanned by one or another of the beams **9** as indicated in FIG. **7**. FIG. **1***a* shows a modified arrangement in which a single long pad or rail **14** continuously turns the bottles as they pass the zone of the side wall inspection device **42**. The shaded areas in the representation of the bottle **3** in successive positions in FIGS. **1** and **1a** indicate the portions of the bottle walls which are scanned as the bottles pass through the scanner **42** from one light beam to the next.

Shortly before their transfer to the output or separating star wheel rotor **11**, the bottles **3** pass through the region **7** of the device (FIG. **8**) for inspecting the bottle bottoms near the end of the bottle passageway in the inspecting star wheel rotor **5**.

A bottle sensor or feeler **15** is located adjacent the infeed conveyor. A bottle sensor or feeler **16** is located at the output conveyor. These feelers sense the flow of bottles to insure proper bottle flow rate. This arrangement is also shown in my copending U.S. Pat. No. 3,607,547 aforesaid. In case of sufficient pressure exerted by the bottles exiting from the machine, the bottle sensor **16** is actuated and through it a variable speed drive **26, 27, 28, 29, 30** (FIG. **2**) adjusts the machine speed up to its capacity. The bottle stop **17** at the input conveyor is concurrently withdrawn, thus permitting continuous infeed of bottles. As explained in copending U.S. Pat. of 3,607,547 aforesaid, the regulator **30** adjusts the variable width pulley **27** for V-belt **41** from the pulley **28** of motor **29**, thus to vary the speed of drive **26**. In the event of a bottle stoppage or gap at the input conveyor **1**, sensor **15** will feel no pressure. This will trigger the variable speed drive to reduce machine speed to a minimum.

Moreover, in case of back pressure of the bottles at feeler **16**, infeed of bottles is stopped by the bottle stop **17**, in order to prevent breaking of the bottles.

In accordance with the present invention, there is a regulating unit **35** for each bottle station on the central inspection star wheel rotor **5**. The regulating unit can be electric, pneumatic or mechanical. In the illustrated embodiments, the regulating units **35** are electromagnets (FIGS. **2** and **5**). Each regulating unit **35** is subject to actuation by the amplifier **50** which in turn is subject to pulsing from any one or more of the mouth inspection device **6**, the bottle bottom inspection device **7** and each of the light ray receivers **10**. Accordingly, it is immaterial at which of the different inspection stations dirty bottles are recognized. Each electromagnet **35** has a sliding cam stem **20**. When the sensing of a dirty bottle triggers the magnet **35** for the station occupied by the dirty bottle, the stem **20** for that magnet is lifted and held in lifted position by permanent magnet-type holder **20**.

Only after the transfer of the bottles to the separating star wheel rotor **11** will the sliding part **20** be again brought back by a rail, not shown, to its retracted position. The sliding part **20**, brought by one of the electro-magnets **35** to its raised position, cams against a transfer arm **21** which is arranged to rotate around its vertical axis, thus to actuate reject mechanism on the output star wheel **11**. The reject mechanism includes blocking units or dogs **24**.

The dogs **24** are pivotally mounted on pintles **19** on the lower star arms of separating star wheel **11**. These dogs **24** are selectively actuated by the swing arm **21** of transfer unit to cause rotation about its axle shaft **23** of the corresponding bottle holding element **25**. Each axle **23** has a coil spring **60** (FIG. **9**) which biases the shaft **23** to rotate clockwise in FIG. **2**. The dogs **24** block this clockwise motion of the shaft **23** and holder arm **25**, until the dog **24** is swung down to an out of the way position by pressure of transfer arm **21** (FIG. **6***b*), whereupon spring **60** swings the arm **25** over the top of the retracted dog **24** (FIGS. **6***c* and **6***d*) and into a dirty bottle retaining position. The shafts **23** also carry arms **61** (FIG. **9**) with cam rollers **22** acted upon by the cam **18** which will withdraw the holding arms **25** from retaining relation to the dirty bottles on star wheel **11** when the bottle reaches the reject conveyor **12**. The profile of cam **18** is such that holding arm **25** continues to hold the dirty bottle as separating star wheel rotor **11** carries it past discharge conveyor **13**. Thereafter, the cam **18** exerts pressure on cam roller **22** to turn shaft **23** counterclockwise against the bias of coil spring **60** and gradually withdraw holding arm **25** away from confining relation to the dirty bottle. In the course of its counterclockwise turning movement, arm **25** cams against the inclined top of blocking dog **24** to restore the dog to its initial position against stop **53** (FIG. **6***a*).

If a clean bottle on inspection star wheel **5** has passed all inspection stations, the reject amplifier **50** will not be pulsed. Accordingly the electromagnet **35** corresponding to the clean bottle will not be energized and sliding cam stem **20** will remain retracted. Accordingly, neither the transfer arm **21** nor the blocking dog **24** will be actuated. Accordingly, blocking dog **24** will maintain its FIG. **6***a* position and prevent coil spring **60** from turning holding arm **25** into reject position.

FIGS. **6***b* and **6***c* show the release of the holding arm **25**. FIG. **6***d* shows how the holding arm **25** is brought via its roller **22** by the cam disk **18** to its starting position (FIG. **6***a*) by pushing it over the blocking dog **24**.

FIG. **3** shows schematically how the bottles **3** are lifted by a slide face or ramp **31** touching the bottle base in the region of the transfer of bottles from the infeed star wheel **4** into the central star wheel **5**. In FIG. **3**, bottle **3'** is shorter than standard and is lifted by ramp **31** into proper carrying position with respect to star wheel **5**. There is also provided a slide face or ramp **32** touching the bottle bottom in the region of the transfer of bottles from the center star wheel **5** to the output star wheel **11** in order to bring overtall bottles, such as tall bottle **3''**, hanging in the central star wheel **5** to the bottle conveyor belt **33**.

The base scanner **7** of FIG. **8** is arranged at the end of the bottle passageway in the central inspection star wheel **5** in order to provide a long distance for removing the foam from

the bottom of the bottle before it reaches the bottom scanner. FIG. 4 shows the foam remover which comprises rotating brushes 37 immersing into a water bath 38. These are arranged to brush the foam from the bottom of the bottle in the region of the central star wheel 5, as the bottles travel on their path through side wall scanner 42. Alternatively, the brushes can be replaced by a foam remover comprising a fluid nozzle jet 51 of air or water 52, as shown in FIG. 4.

FIG. 7 shows schematically how the three light beams 9 of the wall inspection device 42 overlap. Section I shows the inspected part of the bottle wall of the first light beam 9. After that the bottle 3 makes a partial rotation of about 60° and passes then through the second light beam 9 of section II. The bottle then passes the third wall inspection station after a further partial rotation of 60° and is impinged by the beam of section III. The overlapped beams give good assurance that all parts of the bottle wall will receive the direct rays of one or the other of the three beams.

FIG. 8 shows a bottom scanner. A light source 43 for light rays 44 is located in a light well 36. The rays of light 44 are changed into diffused light by a pane or opalized glass 45. The rays 48 coming from the pane of opalized glass 45 are collected by a lens 46 and are transmitted via a rotating scanner 47 to a receiver 10. The receiver 10 triggers an amplifier 50 via the circuit lines 49 whereby the amplifier 50 actuates the appropriate electromagnet 35.

The lip of the bottle mouth is illuminated by a light source in a conventional mouth inspection device 6 in FIG. 1. The image of the bottle mouth reflects to a rotating prism which transfers the reflection to a photocell. If the lip is broken, an uneven reflection will appear, and an impulse is transmitted via an amplifier 50 to the appropriate electromagnet 35 which actuates its sliding part 20 to set in motion the reject mechanism for that particular bottle.

The automatic inspection machine can also operate with less than all of the three inspection devices functioning, depending upon requirements. The machine is versatile because as requirements demand, additional inspection devices can be added without materially increasing expense. Moreover, the inspection machine can be adapted to inspect bottles of different height, diameters and shapes.

The embodiment of FIG. 1*a* differs from the embodiment of FIG. 1 with respect to the form and operation of the bottle turning rail 14, as hereinbefore described, and also with respect to the location of the reject conveyor 12. In FIG. 1, reject conveyor 12 is perpendicular to discharge conveyor 13 and line up tangentially with output star wheel 11. In FIG. 1*a*, reject conveyor 12 is parallel to discharge conveyor 13 and receives rejected bottles from star wheel 11 via a transfer star wheel 54.

I claim:

1. In automatic apparatus for inspecting for dirt empty transparent containers and in which the containers are transferred from a conveyor to an infeed rotor, to an inspection rotor and thence to a separating rotor, the improvement in which there are separate inspection sensors beyond the infeed rotor and all associated with the inspection rotor for respectively inspecting the side wall and bottom of the container and common dirty container segregating mechanism associated with the separating rotor and a common regulating unit which responds to both of the separate inspection sensors for actuating said container segregating mechanism and segregating dirty containers from clean containers on the separating rotor.

2. The invention of claim 1 in which there is another separate inspection sensor associated with the inspection rotor for inspecting breaks in the lip of the container, said common regulating unit being also responsive to said other separate inspection sensor.

3. The invention of claim 1 in which the inspection sensor for the bottom of the container is disposed near the end of the path of travel of the containers on the inspection rotor, and foam removing apparatus is associated with the inspection rotor in advance of the bottom inspection sensor.

4. The invention of claim 3 in which the foam removing apparatus comprises brushes rotating in a water bath and against the container bottoms.

5. The invention of claim 1 in which the inspection sensor for the side wall of the container comprises successive light beams through which the container passes successively, and mechanism to rotate the container between successive beams.

6. The invention of claim 5 in which the successive light beams emanate from a single light source near the center of the inspection rotor and radiating toward the periphery thereof.

7. The invention of claim 1 in which the common dirty container segregating mechanism associated with the separating rotor comprises container holders having holding and non-holding positions, and mechanism responsive to the regulating unit to selectively position the holder in one or the other of said positions.

8. The invention of claim 7 in which the container holders comprise arms spring biased toward container holding positions, said mechanism comprising blocking dogs restraining said arms from moving toward said container holding positions and dog displacing arms responsive to the regulating unit to displace said dogs from blocking relation to the arms.

9. The invention of claim 7 in which the mechanism further comprises a sliding cam shaft actuated by the regulating unit, said dog displacing arms having a portion in the path of the actuated cam shaft whereby to trigger said mechanism responsive to the actuation of the regulating unit.

10. The invention of claim 7 in which the regulating unit comprises an electromagnet which energizes the sliding cam shaft and a holding magnet which retains the cam shaft in its actuated position.

11. The invention of claim 1 in which there is an inclined slide ramp between the inspection rotor and the separating rotor to adjust the vertical position of containers transferred therebetween.

12. The invention of claim 8 in which said holding arms have cam followers, said separating rotor having a stationary cam which engages the said cam followers to move the holding arms to non-holding position when the container reaches reject position.

13. The invention of any claim 1 in which there is a variable speed drive for the rotors, and bottle feelers at the input and output ends of the apparatus to which the variable speed drive responds.

* * * * *