Jan. 21, 1969 R. SPURR 3,422,542

CONTAINER INSPECTION MACHINE

Filed Sept. 1, 1965 Sheet 1 of 8

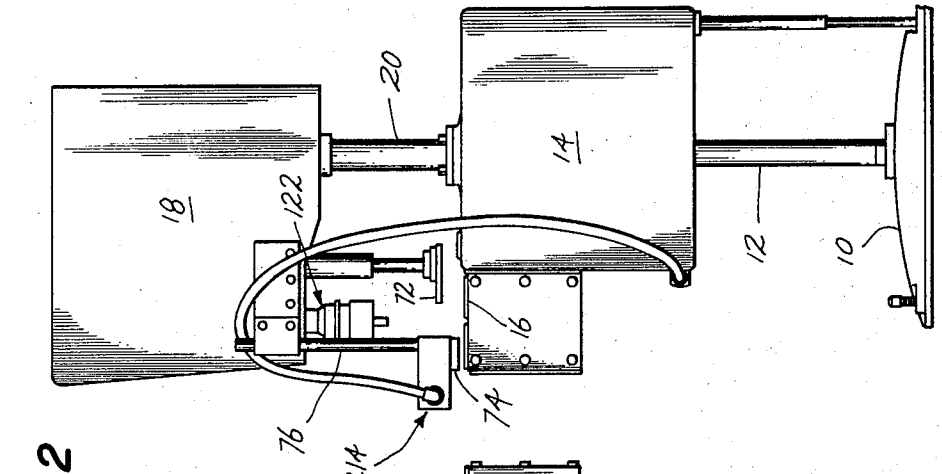


FIG. 2

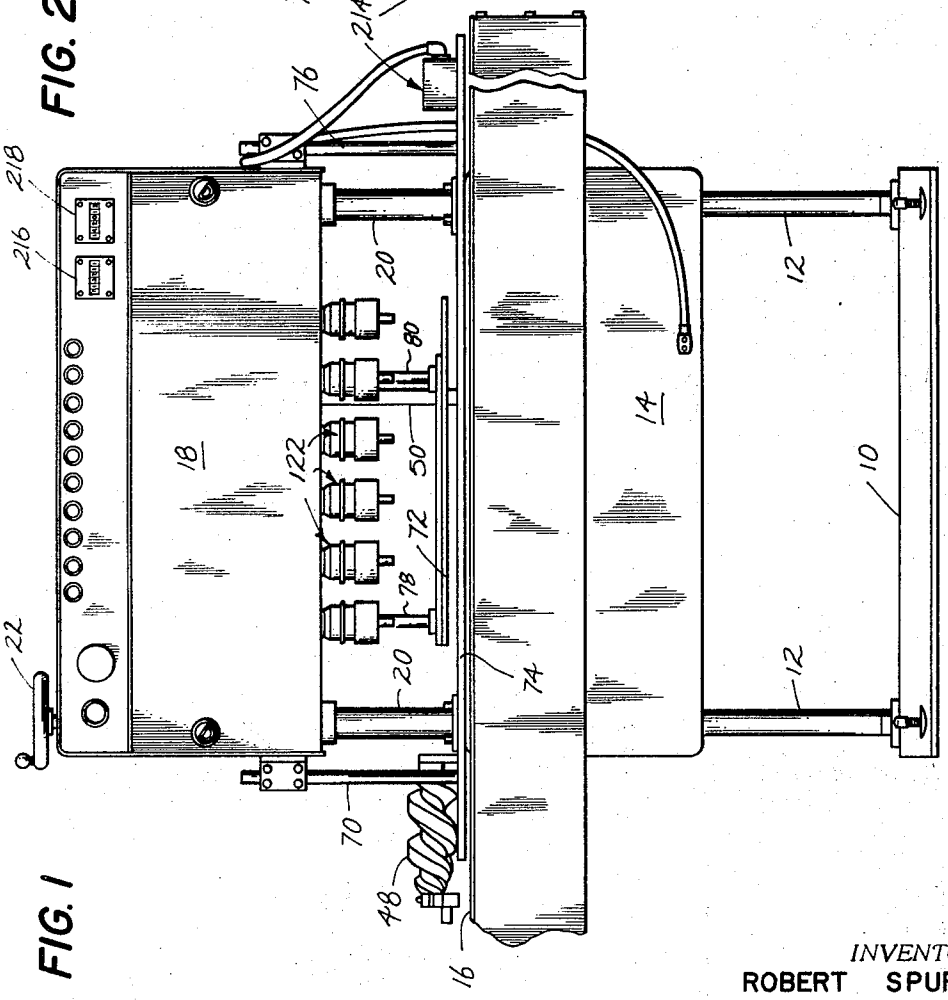


FIG. 1

INVENTOR.
ROBERT SPURR

BY
McCormick, Paulding & Huber

ATTORNEYS

CONTAINER INSPECTION MACHINE

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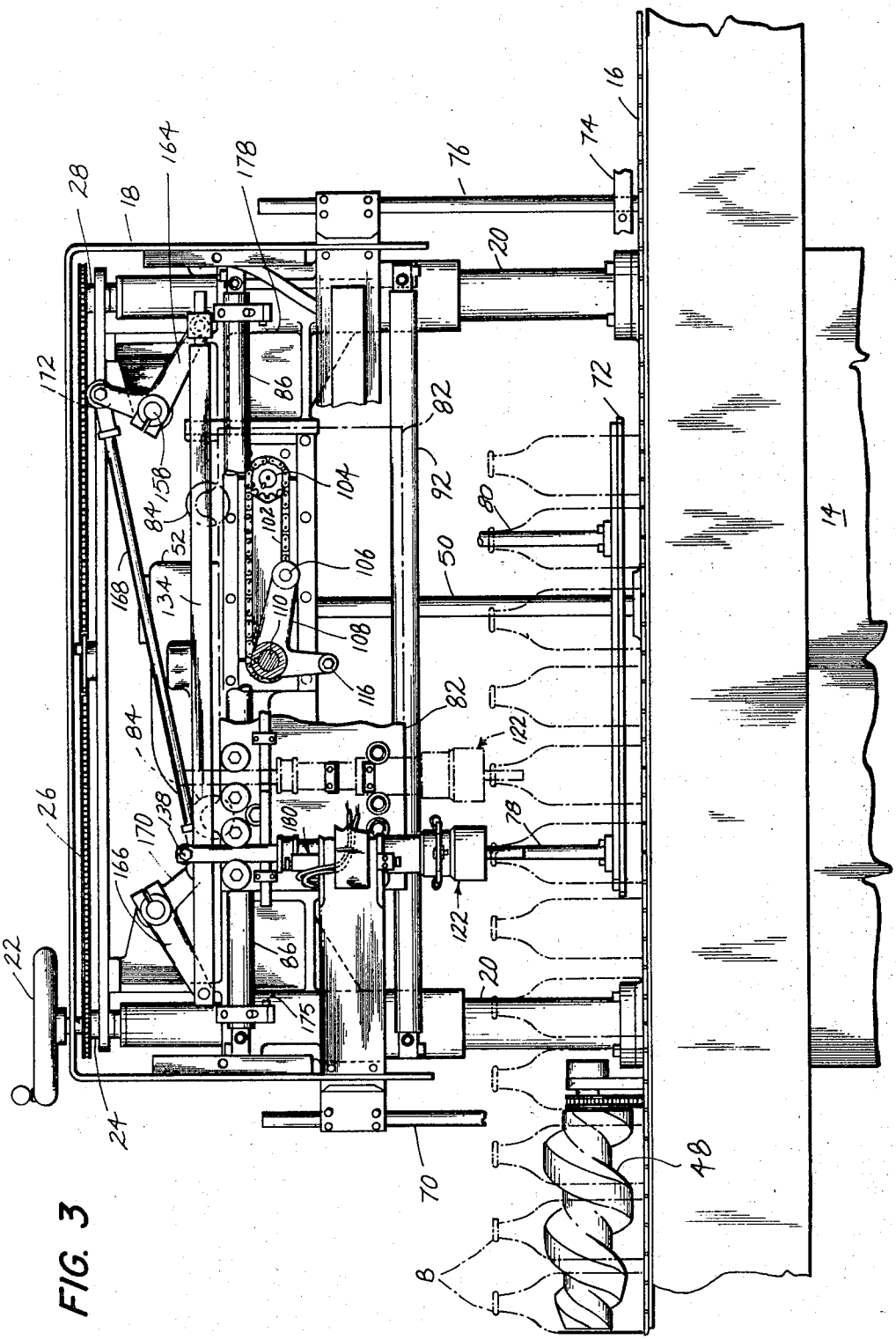


FIG. 3

CONTAINER INSPECTION MACHINE

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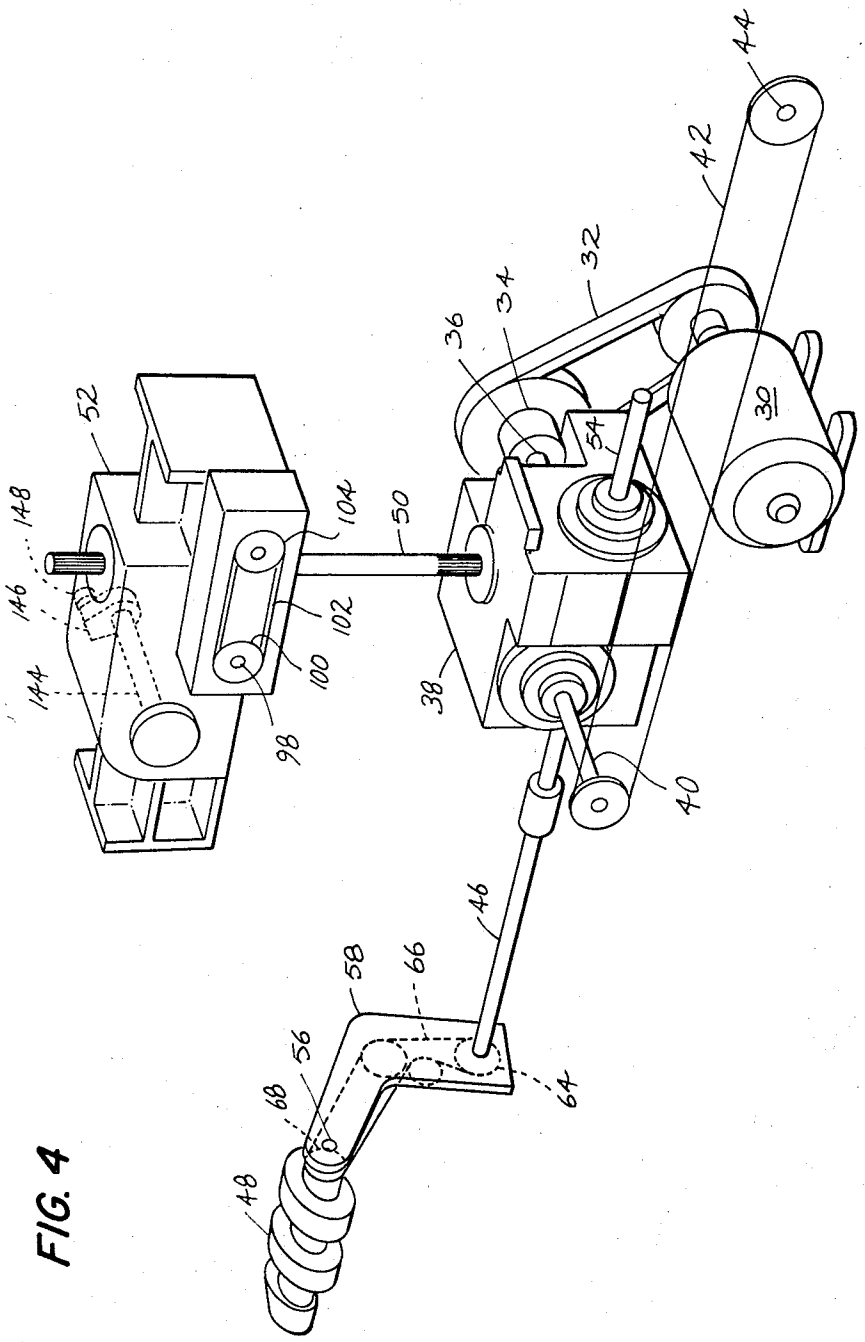


FIG. 4

FIG. 5

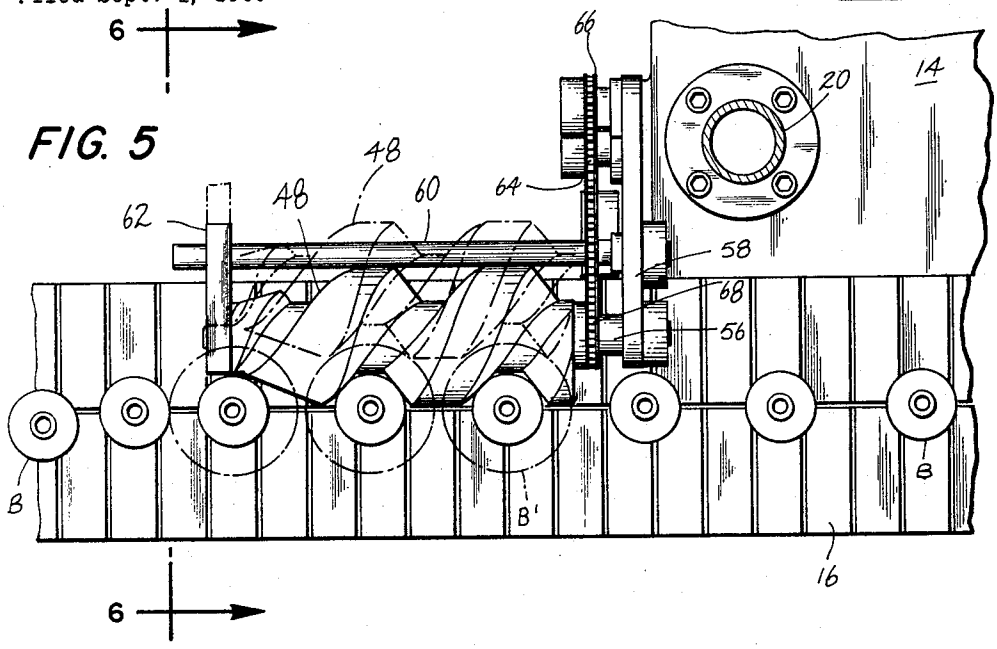
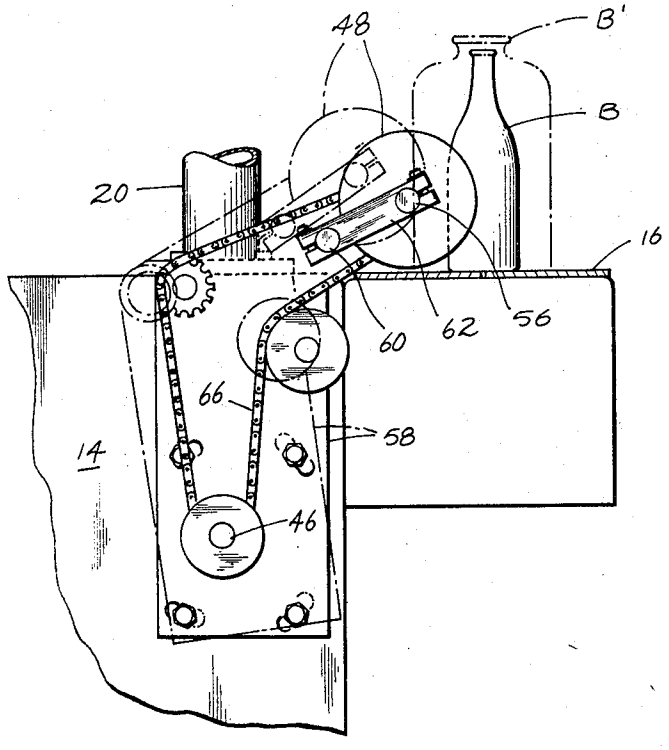

6
66
20
14
48
48
60
64
62
58
68
56
B
B'
B
16
6

FIG. 6


48
B'
B
20
16
60
62
56
66
58
14
46

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CONTAINER INSPECTION MACHINE

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FIG. 7

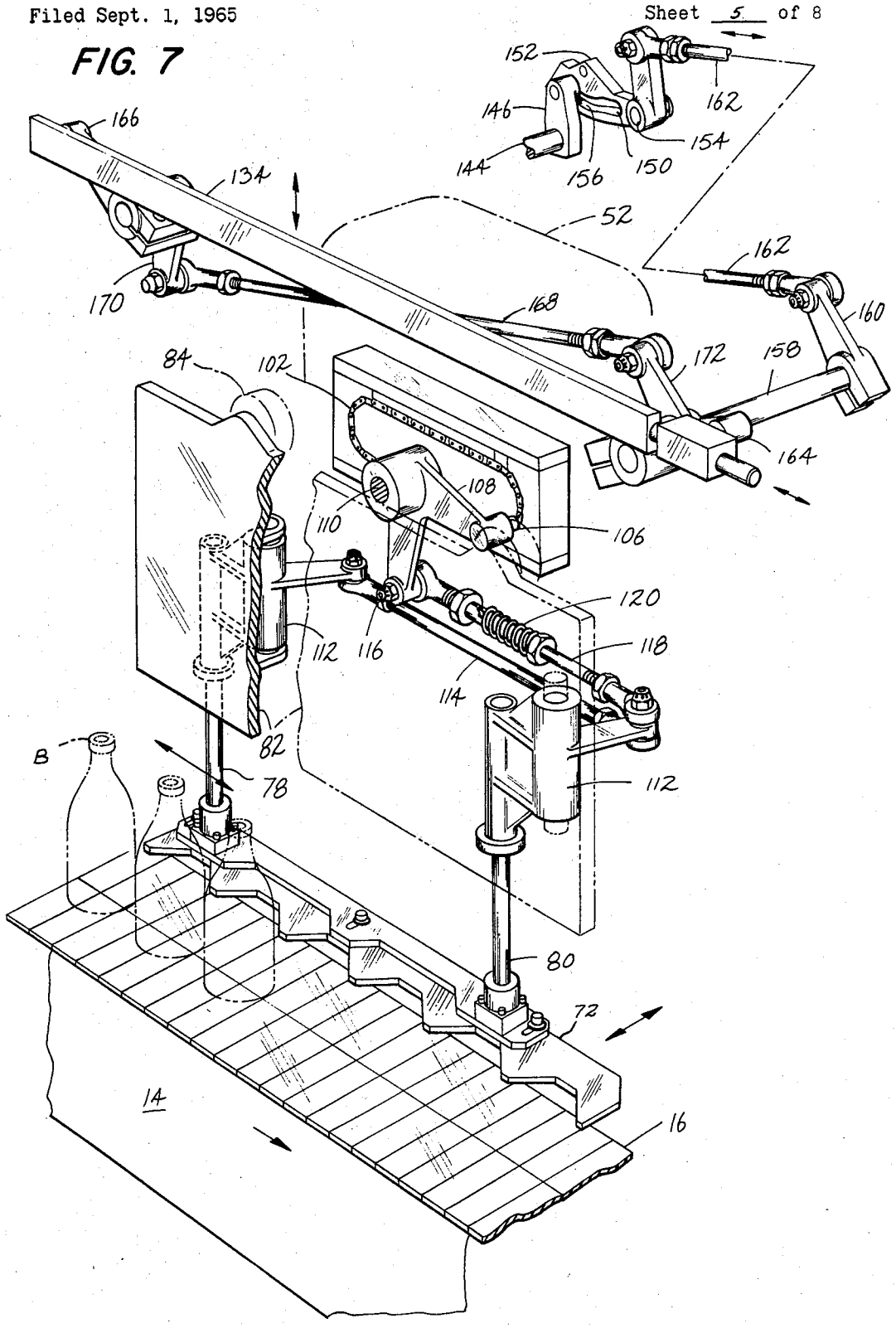


FIG. 8

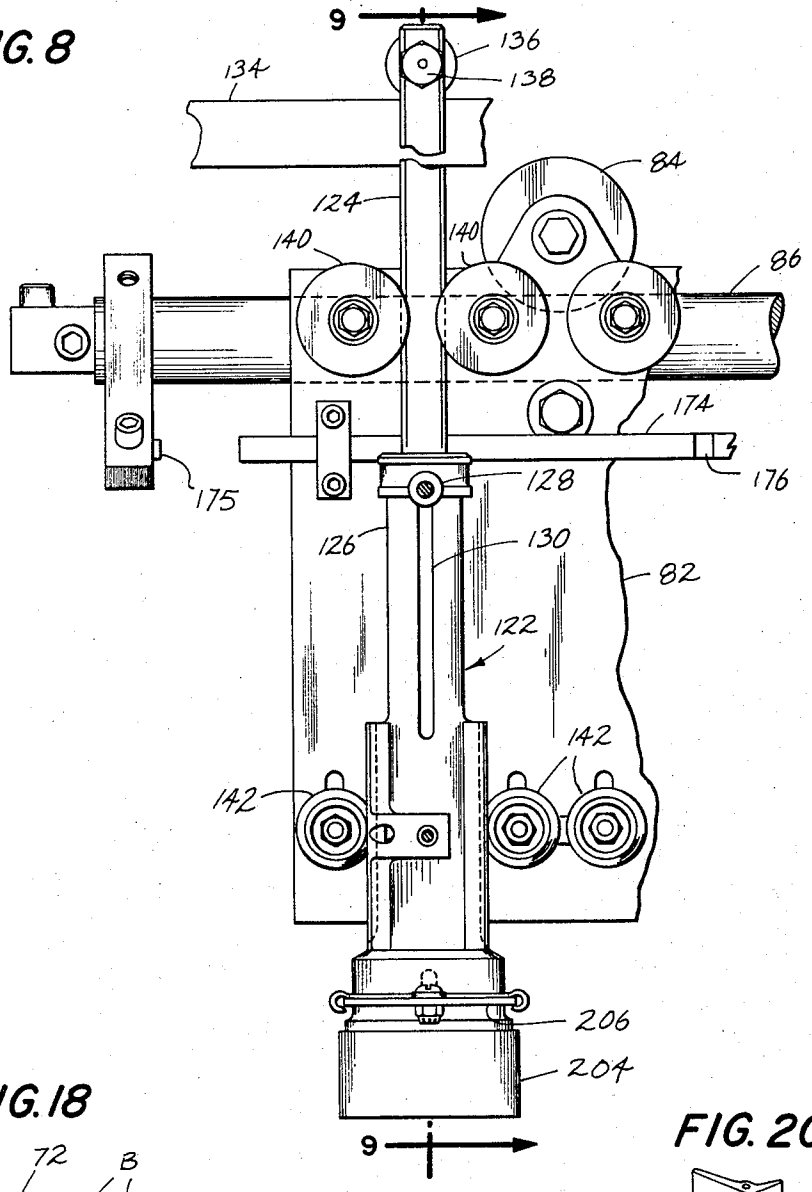


FIG. 18

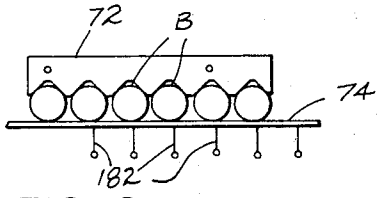


FIG. 19

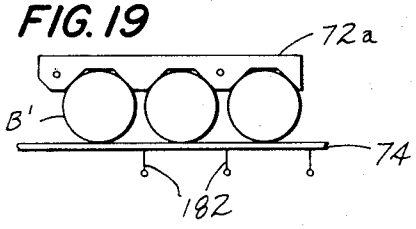


FIG. 20

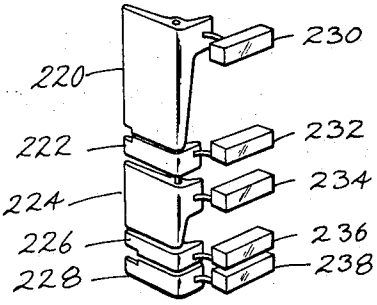
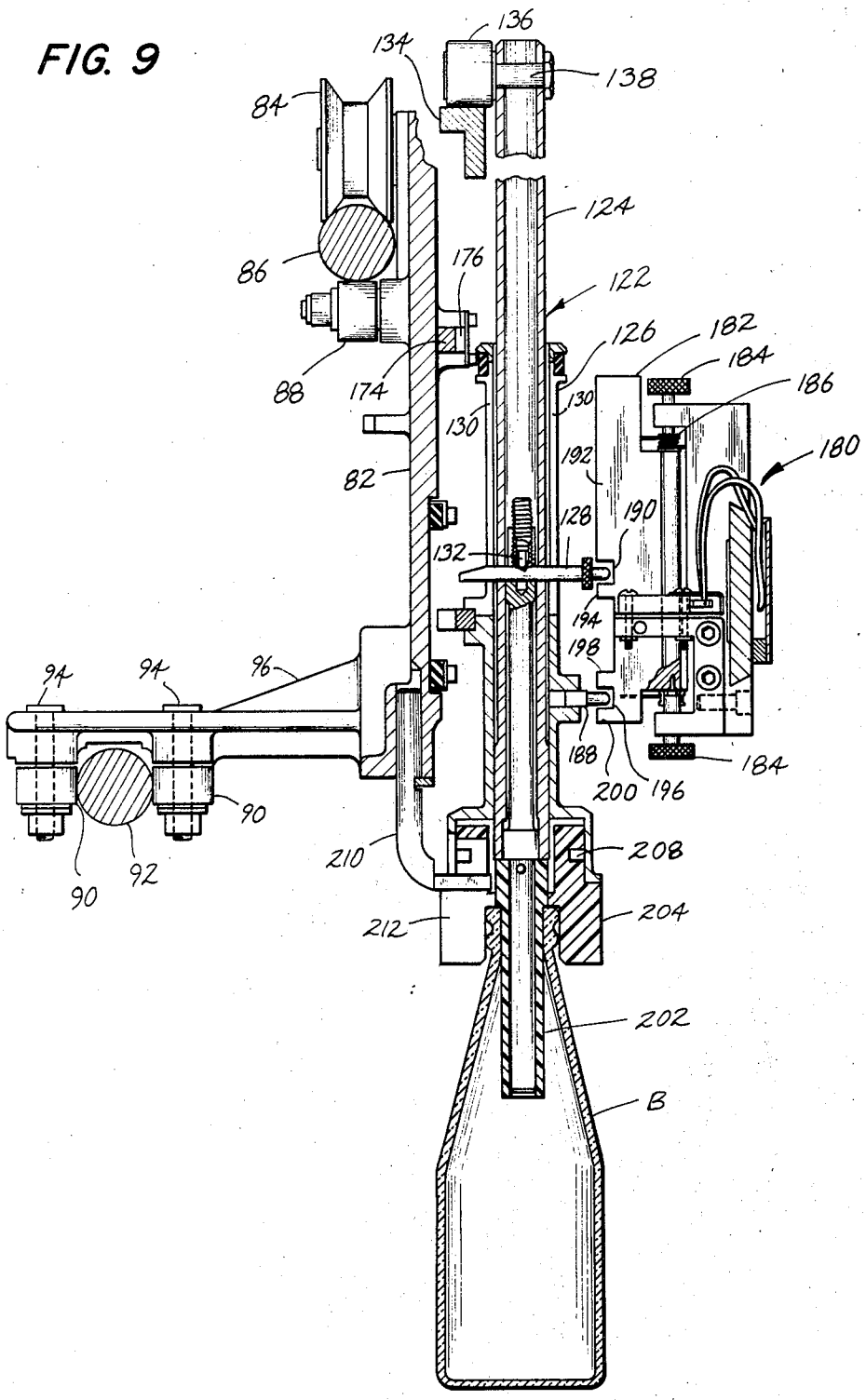


FIG. 9


136
134
138
84
124
86
176
122
126
182
184
186
88
174
130
130
180
192
82
128
190
132
194
198
94
94
96
188
184
200
196
90
210
208
92
90
212
204
202
B

CONTAINER INSPECTION MACHINE

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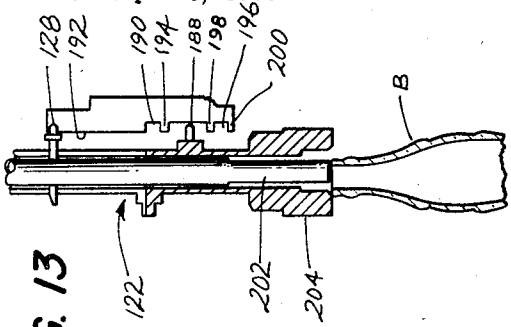


FIG. 13

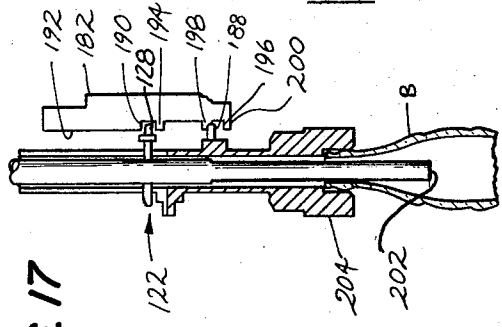


FIG. 17

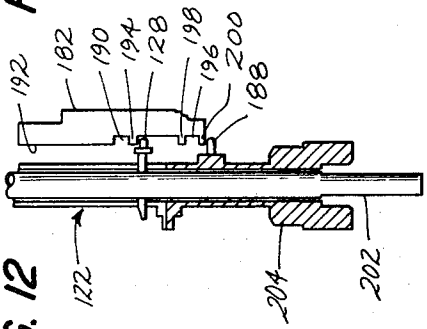


FIG. 12

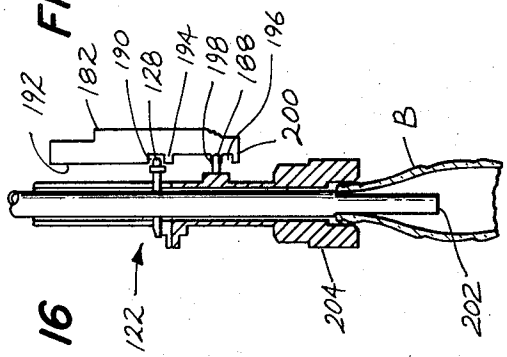


FIG. 16

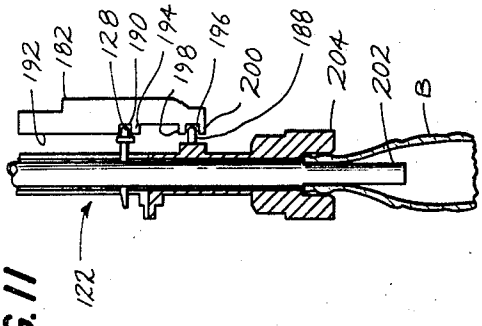


FIG. 11

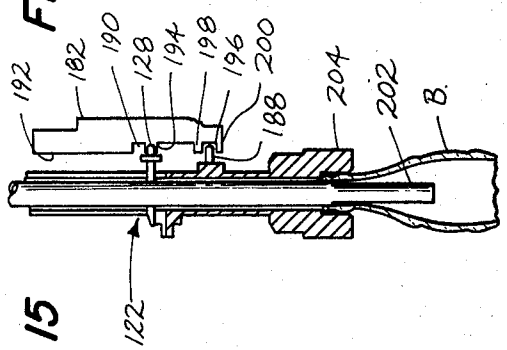


FIG. 15

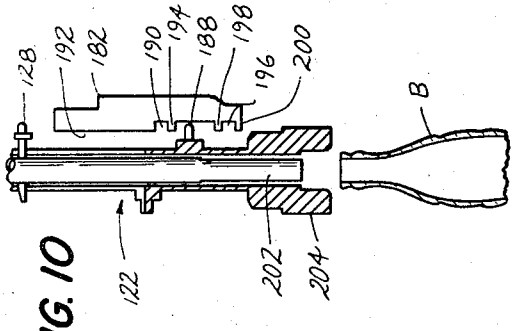


FIG. 10

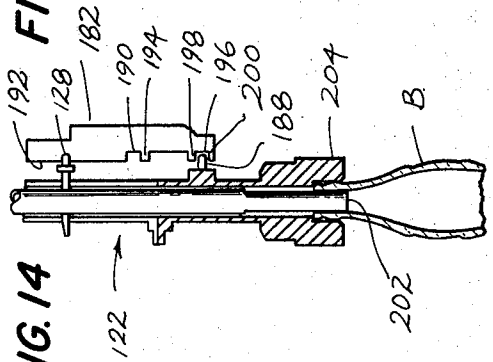


FIG. 14

United States Patent Office 3,422,542 Patented Jan. 21, 1969

3,422,542

CONTAINER INSPECTION MACHINE

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Filed Sept. 1, 1965, Ser. No. 484,190
U.S. Cl. 33—174 12 Claims
Int. Cl. G01b

ABSTRACT OF THE DISCLOSURE

A machine for inspecting containers, especially glass bottles, while they are being transported in a line on a conveyor. Inspection is made for defects in height and the inner and outer dimensions of the necks and for "leaners." The machine includes a mechanism which reciprocates over the conveyor and longitudinally thereof, this mechanism having a plurality of testing devices which are lowered automatically to engage and test a series of bottles simultaneously while the mechanism is moved in the direction of the conveyor, and then the mechanism is returned to engage the next equal series of bottles on the conveyor.

This invention relates to a container inspection machine and, more specifically, to a machine which is particularly adapted for the inspection of glassware containers such as bottles, jars and the like for various dimensional imperfections.

It is a general object of the invention to provide a compact, simply installed machine for inspecting or gaging bottles or like articles as to several of their dimensions in anticipation of their subsequent use in automatic filling machines, capping machines and the like. That is, it is desired to provide a machine which will inspect or gage the containers to be sure that they are of proper height, that they have correctly located openings of proper size to receive filling tubes, and to be sure that the container "finish" around such openings are such that they can be properly capped, whereby to avoid jamming or other malfunction of the filling and capping machines or other machines which must later handle the containers.

Another object of the invention is to provide a container inspecting machine having the foregoing characteristics and which is readily adaptable for use with but a minimum of adjustment for a wide variety of containers of various sizes and shapes.

A further and more specific object of the invention is to provide such a machine for inspecting containers which is fully automatic and which is adapted to inspect simultaneously a plurality of containers moving in a continuous single line and which is also adapted to perform the inspection operations at a high rate of speed which is in keeping with the high rate of speed at which containers can be manufactured for inspection.

As will be described in greater detail hereinafter, the machine provided in accordance with the present invention includes a continuously moving conveyor of the link-belt type which can readily be aligned with an infeed conveyor and with a take-away conveyor. Feed means are associated with the machine conveyor to arrange bottles or other containers to be inspected in regularly spaced positions in a single line on the moving conveyor so that the bottles will be properly spaced as they move through the machine.

The machine includes a head which reciprocates longitudinally of the conveyor and which during its operating stroke moves along with and in operative association with a selected number of bottles to be inspected. There is a bottle support structure carried by this head which engages the bottles during the operating stroke of the head

to assure their proper position for engagement by vertically movable inspecting devices which move down to engage the bottle top portions. The inspection of the plurality of bottles is completed in a very brief time, and a dimensional imperfection in a bottle or in any one of the bottles causes the vertically movable inspecting device to be improperly positioned vertically. The improper position of the inspecting device causes it to engage and actuate a switch mechanism as the inspection head moves along with the bottles on the conveyor. The actuation of the switch operates a rejection mechanism through a memory circuit to reject the imperfect bottle after it and the series of bottles in which it is included has moved away from the inspection head. The bottle positioning structure disengages itself from the inspected series and on the return stroke of the head it is re-positioned to engage the next series of bottles to be inspected.

The drawings show preferred embodiments of the invention and such embodiments will be described, but it will be understood that various changes may be made from the constructions disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a front elevational view of a container inspection machine incorporating the features of the present invention;

FIG. 2 is a right-hand end view of the machine shown in FIG. 1;

FIG. 3 is an enlarged front elevational view of the upper portion of the machine shown in FIG. 1 but with the front panel removed therefrom to reveal details of construction;

FIG. 4 is a schematic perspective view of the drive train utilized in the machine;

FIG. 5 is an enlarged top view of a portion of the machine conveyor at the infeed end thereof;

FIG. 6 is a vertical sectional view taken through the machine conveyor as indicated by the line **6—6** of FIG. 5;

FIG. 7 is a rather diagrammatic perspective view of the inspection head or head plate and showing the manner in which it is operated within the machine;

FIG. 8 is a front elevational view showing one of the vertically reciprocable inspecting devices carried by the head plate;

FIG. 9 is a vertical sectional view taken through the inspecting device as indicated by the line **9—9** of FIG. 8 but showing the device in engagement with a bottle being inspected;

FIGS. 10 through 17 show rather schematically the operation of the testing or gaging device, FIG. 10 illustrating the device in its elevated position, FIG. 11 showing the device in its lowered position and engaging a bottle which passes inspection, FIG. 12 showing the device in a lowered position with no bottle present to be inspected, FIG. 13 showing the device as it engages a "leaning" or distorted bottle, FIG. 14 showing the device engaging a bottle which has too small of a neck opening, FIG. 15 showing the device engaging a bottle which has too large of a neck opening, FIG. 16 showing the device engaging a bottle which has an oversize finish surrounding the neck opening, and FIG. 17 showing the device engaging a bottle which is too tall;

FIG. 18 is a schematic top plan view of the bottle positioning structure of the machine adapted to engage for inspection a series of six bottles;

FIG. 19 is a view similar to FIG. 18 but shows the bottle support structure adapted to engage and inspect

three bottles in a series of bottles which are of larger diameter; and

FIG. 20 is a perspective view showing an alternative reject switch actuating structure.

As seen in FIGS. 1 and 2, the machine of this invention has a floor base **10** from which legs **12, 12** extend to support a lower cabinet and frame structure **14**. A drive motor and other drive mechanisms are located within the lower cabinet **14** and they include means for driving an endless link belt type conveyor **16** which extends across the front of the machine with its upper extent horizontal and moving from left to right as viewed in FIGS. 1 and 3.

The frame structure of the machine also includes an upper cabinet **18** which is supported over the lower cabinet **14** on a pair of posts **20, 20**. The upper cabinet **18** houses the test apparatus which performs the gaging or testing on the containers, such as the bottles B, B (FIG. 3), which are moved along the upper extent of the conveyor **16** below the overhanging front portion of the upper cabinet **18**. The said upper cabinet and the testing apparatus which it supports can be adjusted vertically for use in association with other bottles or other containers of different height by turning a handwheel **22** located at the top of the said cabinet. This handwheel **22** rotates a shaft **24** which is threaded into one of the posts **20**, and by means of a sprocket and chain connection **26** (FIG. 3) a similar shaft **28** is rotated within the other post **20**. Thus, in rotating the handwheel **22** in one direction, the upper cabinet **18** and all of the mechanism which it houses is raised on the posts **20, 20**, and rotation of the handwheel in the opposite direction lowers the cabinet and mechanism on the said posts.

As was mentioned, much of the drive structure for the machine of this invention is located within the lower cabinet **14**. As shown quite schematically in FIG. 4, this drive structure includes an electric drive motor **30** having its drive shaft connected as by a belt **32** and a variable speed pulley **34** to the input shaft **36** of a gear box **38**. There are four output shafts extending from the gear box **38**, one of which is the shaft **40**. The output shaft **40** is connected as by a chain and sprocket or by a belt and pulley or other suitable motion transmitting means indicated generally at **42** to drive the front shaft **44** for the endless belt conveyor **16**. The conveyor shaft **44** is located at the right-hand end of the conveyor **16** as it is viewed in FIG. 1.

Another of the driven output shafts extending from the gear box **38** is the cycle shaft **46** which extends horizontally to the left to project outside of the lower cabinet **14** for driving connection, as will be described, to a feed worm **48** which moves the bottles B, B or other containers into properly spaced positions on the conveyor **16** as they are moved through the machine.

Another of the driven output shafts from the gear box **38** is the splined vertical shaft **50** which extends upwardly into the upper cabinet **18** and into an upper gear box **52** located therein. The upper gear box **52** has output shafts which operate the testing mechanisms or apparatus as will be described, and the shaft **50** is splined to accommodate the vertical adjustment of the upper cabinet **18** and the testing mechanisms without disconnecting the driving engagement with the lower gear box **38**.

The last output shaft from the lower gear box **38** is the shaft **54** which extends horizontally in the opposite direction from the cycle shaft **46**. The shaft **54** is not used in the machine as shown herein, but it is provided as a drive shaft for accessory equipment which can be associated with the machine. The shaft **54** can also be used as a cycle shaft if the bottles are moved on the conveyor in the opposite direction.

Turning now to a description of the operation of the feed worm **48** and the mechanism associated therewith, reference will be made particularly to FIGS. 3–6. It will be seen that the feed worm **48** is mounted on a shaft **56** which extends horizontally and longitudinally of the conveyor **16** near the inner or rearward longitudinal edge thereof. The worm shaft **56** is fixedly supported adjacent its right-hand end in a bracket **58** which is pivotally adjustably mounted on the left-hand end of the lower cabinet **14** for pivotal adjustment about the axis of the cycle shaft **46** which projects outwardly from the said left-hand end of the cabinet. A support bar **60** also extends outwardly from the bracket **58**, and an outer bracket **62** is connected between the outer or left-hand end of the support bar and the outer or left-hand end of the worm shaft **56** to help support the worm in the horizontal position.

A drive sprocket **64** is connected to the projecting end of the cycle shaft **46** to drive a chain **66** which is entrained over a driven sprocket **68** on the worm **48** whereby the said worm is rotated on its support shaft **56**. As the said worm is driven, its flutes receive the bottles B, B or other containers in equally spaced relationship between its flights or convolutions. As the bottles move along on the conveyor **16**, they are moved into engagement with the feed worm **48** by means which have not been shown as a matter of drawing convenience. Such means preferably comprises a series of spring loaded fingers which are located over and along the conveyor **16** opposite the left-hand end of the worm **48**. These fingers project rearwardly to guide the bottles into engagement with the worm. Also, means are provided to maintain the bottles in engagement with the worm and such means may comprise an arm (not shown) which can be pivotally supported over the conveyor on the vertical post **70** (FIGS. 1 and 3) which is supported at the left-hand end of the upper cabinet **18**. This arm is preferably spring biased to swing toward the worm **48** and thereby maintain the bottles in engagement with the worm.

The purpose of having the worm support bracket **58** pivotally adjustably supported on the lower cabinet **14** is to use the same worm in the handling of bottles or other containers of different size, as is shown in FIGS. 5 and 6. When the bottles B, B are of relatively small diameter, the bracket **58** is adjusted about its pivot on the axis of the cycle shaft **46** so as to project the worm **48** forwardly over the conveyor to the full line position shown. In handling of such relatively small diameter bottles, the bottles engage rather deeply in the flutes of the worm. When a rather large diameter bottle such as the bottle B', shown in broken lines in FIGS. 5 and 6, is being tested, the bracket is pivoted to move the worm **48** rearwardly to the broken line position shown. In operating upon the large diameter bottles B', the bottles engage only the outer portions of the worm flutes.

As the bottles B, B leave the feed worm **48** they are located substantially along the center line of the conveyor **16** in equally spaced relationship wherein the spacing is quite precise as dictated by the size and pitch of the feed worm. This rather precise spacing of the bottles and control of conveyor speed are desirable and are accomplished so that the bottles can be easily engaged by a notched rake **72** which is shown in FIGS. 1–3 and 7 and which is operated in synchronization with the conveyor. This rake in the example shown is provided with six evenly spaced notches for engagement simultaneously with a series of six bottles B, B which have been spaced by the feed worm. The rake is supported horizontally over the conveyor **16** with its notches facing forwardly toward a horizontal guide rail **74** which extends across the front of the machine over the conveyor and which is supported on the left-hand post **70** and a similar right-hand post **76** which is supported at the righ-hand end of the upper cabinet **18**. The rake **72** and guide rail **74** are preferably supported in substantially the same horizontal plane, but for convenience of illustration the rake **72** has been shown slightly above the plane of the guide rail **74** in FIGS. 1 and 2.

The rake is supported on two vertical posts which are spaced apart longitudinaly of the rake. These posts are designated the left-hand post **78** and the right-hand post **80**. These posts depend from the equipment within the

upper cabinet **18** and they are so supported by such equipment (as will be described) that the rake **72** can be moved forwardly on a slight arc while maintaining a parallel relationship with the center line of the conveyor **16**. In such forward movement, the rake engages a series of six bottles being moved along by the conveyor **16** within its notches, pressing the bottles against the longitudinally extending guide rail **74**. This precisely positions the bottles for testing operation by the overhead testing devices which will be described. Then, the rake is moved along longitudinally and in precisely timed relationship with the movement of the conveyor **16** for a sufficient distance to permit completion of the testing operations simultaneously on the six engaged bottles. Then, the rake is moved rearwardly, but on a slight arc while maintaining parallel relationship with the center line of the conveyor. This disengages the rake from the six bottles which have been tested, and the rake is then moved toward the left, opposite to the direction of movement of the conveyor **16**, to its initial position. Then, the rake is moved forwardly again to engage the next series of six bottles being moved by the conveyor.

The means moving the left and right rake support posts **78** and **80** and for thus moving the rake as described is operatively associated with the testing devices to be described and is located within the upper cabinet **18**. The said means includes a head plate **82** (FIGS. 3, 7, 8 and 9). The said head plates is reciprocated in a straight horizontal path extending longitudinally of but over the conveyor **16**. The head plate is supported for such reciprocation and in a vertical plane on a pair of upper rollers **84**, **84** which are rotatable on pins extending horizontally rearwardly from the upper end of the head plate, the rollers riding along a horizontal upper guide bar **86** which extends from left to right in the upper cabinet **18**. One or more rollers **88** located on pins extending rearwardly from the head plate **82** engage the underside of the upper guide bar **86** to prevent the rollers **84**, **84** from becoming disengaged from the guide bar as the head plate is reciprocated longitudinally of the machine. The head plate is further supported for such reciprocation and to insure vertical positioning of the head plate and its associated elements by a pair of rollers **90**, **90** engaging the front and rear sides of a lower guide bar **92**. The rollers **90**, **90** are rotatably supported on vertical pins **94**, **94** which hang from a rearwardly extending bracket **96** secured to the head plate **82**. Preferably, there are two such brackets provided, one of the brackets being shown in FIG. 9.

The head plate is driven back and forth by an output shaft **98** (FIG. 4) which projects horizontally forwardly from the upper gear box **52** within the upper cabinet **18**. A sprocket **100** is secured to the projecting front end of the shaft **98** to receive a chain **102** which is also entrained over a sprocket **104**. This chain is supported throughout its upper and lower extents to properly position the rake for inspection operation.

As best shown in FIGS. 3 and 7, the pivot pin **106** on one end of a bell crank **108** is carried by one of the links of the chain **102** throughout its path of movement which is counterclockwise as viewed in these figures. The intermediate pivot pin **110** of the bell crank **108** is journaled in the head plate **82** to extend rearwardly therefrom. Thus, as the bell crank **108** follows the path of the driven chain **102**, the head plate is reciprocated between its furthermost left-hand and right-hand positions. Obviously, the bell crank will pivot about its intermediate pivot pin **110** when the end pin **106** swings upwardly to the upper extent of the chain **102** at the right-hand end limit of motion of the head plate **82**, and the said bell crank will also be pivoted as the end pin **106** swings downwardly at the left-hand limit of motion of the head plate.

It is this swinging or pivoting motion of the bell crank **108** which is used to move the rake respectively rearwardly and forwardly at the right and left-hand limits of head plate travel. This can best be understood by reference to FIG. 7 wherein it is shown that the left and right-hand rake support posts **78** and **80** are supported on the ends of a pair of bell crank brackets **112**, **112** which are mounted on the rear of the head plate **82** for pivotal movement on vertical axes. The free arms of the bell crank brackets **112**, **112** are interconnected for simultaneous identical movement by a cross link or interconnecting link **114** and the free arm or end of the right-hand bell crank bracket **112** is connected to the third or other end pivot pin **116** on the bell crank **108** by a spring loaded connecting arm **118**.

Thus, as can be readily understood by reference to FIG. 7, when the bell crank **108** swings counterclockwise at the limit of right-hand movement of the pin **106** on the drive chain **102**, which is the limit of right-hand movement of the head plate **82**, the bell crank brackets **112**, **112** will be pivoted generally clockwise as viewed in this figure to move the rake **72** rearwardly out of engagement with the bottles B, B in a slight arc. Likewise, when the limit of left-hand movement of the head plate **82** is reached, the bell crank **108** will be pivoted clockwise and this will cause counterclockwise movement of the bell crank brackets **112**, **112** to move the rake **72** forwardly on a slight arc into engagement with a new series of six bottles. It is significant to note that the engagement of the rake **72** with the bottles is resilient. That is, the rake **72** can be forced rearwardly against the compression of the spring **120** which loads the connecting arm **118**. There is an advantage in this in that bottle breakage is avoided in the event a bottle is knocked over and is resting on its side while moving along the conveyor **16** as the rake **72** moves forwardly toward its engaged position.

We shall now consider the inspecting devices per se of which there are six in number, each being indicated generally by the reference number **122**. These inspecting devices **122**, **122** are supported for vertical movement relative to the head plate **82** and move horizontally with the head plate so that there will be one such inspecting device operatively associated with each bottle in the series of six positioned by the rake **72** below the head plate and moving along the conveyor **16**.

As best shown in FIGS. 8 and 9, the testing device **122** comprises a tube **124** which fits downwardly into a sleeve **126**. As will be described hereinafter, the telescoping tube and sleeve carry test or gaging elements at their lower ends, and they are interconnected by a locking pin **128**. That is, the locking pin **128** is thrust rearwardly through diametrically opposed vertical slots **130**, **130** in the sleeve **126** and it is thrust through suitable holes which are diametrically opposed in the wall of the tube **124**. A spring loaded detent pin **132** within the tube **124** engages in a notch in the locking pin **128** when it is properly positioned. Thus, the tube **124** is free to move axially within the sleeve **126**, its limit of such movement being fixed by the upper and lower end of the slots **130**, **130** when they are engaged by the transversely or forwardly and rearwardly extending locking pin **128**. The detent pin **132** is actually carried within the tube **124** at the upper end of a probe, which will be described, and thus locking pin **128** serves to secure the said probe in the tube.

All six testing devices **122**, **122** move downwardly into operative association with the six bottles of the series engaged by the rake **72** when the head plate **82** starts to move from left to right. All six testing devices are lifted simultaneously as the head plate reaches or approches the right-hand end of its travel. The testing devices are lowered by gravity and are lifted simultaneously by a horizontal lift bar **134** (FIGS. 3, 7, 8 and 9) which also acts to control the rate of dropping movement of the testing devices at less than the speed of gravity. The operation or movement of the lift bar **134** will soon be described, but for the present it is to be observed that the lift bar extends horizontally to engage beneath a roller **136** on the rear end of a pin **138** projecting rearwardly from

the upper end of the inner tube **124** of each testing device **122**.

The vertical movement of each testing device **122** is guided between a pair of upper rollers **140**, **140** which are rotatable on the front face of the head plate **82** and which engage the inner tube **122** on opposite sides thereof. The vertical movement of each testing device is further guided by a pair of lower rollers **142**, **142** on the front of the head plate and which engage opposite sides of the sleeve **126**.

The drive and movement of the lift bar **134** will be described with reference to FIGS. 4 and 7 wherein it will be seen that an output shaft **144** from the upper gear box **52** extends rearwardly therefrom and rotates a crank **146** at its outwardly projecting end. The free end of the crank **146** has a roller **148** thereon which rides in a cam slot **150** in one arm **152** of a bell crank which pivots on a shaft **154** mounted in the machine frame. As the crank **146** is rotated, it rocks the said bell crank on its pivot pin or shaft **154** in a clockwise and counterclockwise direction as viewed in FIG. 7. However, there is a dwell in this rocking movement of the bell crank caused by the configuration of the cam slot, the cam slot configuration causing the dwell being indicated by the reference number **156**.

When the bell crank is pivoted clockwise on the pin **154**, it rotates a rock shaft **158** (FIG. 7) clockwise, the said rock shaft and bell crank being interconnected by a crank arm **160** and a connecting link **162**. A crank arm **164** on the other end of the rock shaft **158** is pivotally connected to the lift bar **134** at the right-hand end thereof to move the said bar toward the right and downwardly. The bar is kept in a horizontal plane by means of another crank arm **166** pivotally connected to the other end of the lift bar **134** and which is pivoted by means of a diagonal link **168** connected to a crank arm **170** on the same axis as the crank arm **166** and also connected to a crank arm **172** on the same axis as the crank arm **164**. When the bell crank is rocked counterclockwise on the pivot **154** by the crank **146**, the lift bar **134** is moved upwardly.

The timing relationship between operation of the lift bar **134** and the reciprocation of the head plate **82** is achieved in the gear box **52** and is such that the lift bar **134** will be lowered and raised during movement of the head plate **82** from left to right. Likewise, the lift bar **134** will again be lowered and raised during movement of the head plate from right to left. However, the lowering and raising of the lift bar during left-to-right movement of the head plate is effective to lower and raise the testing devices **122**, and the lowering and raising of the lift bar during right-to-left movement of the head plate is ineffective to lower and raise the testing devices.

That is, when the head plate **82** reaches the left-hand limit of its travel, a horizontal locking bar **174** slidably carried by the head plate **82** will engage a stop **175** on the machine frame to shift the locking bar **174** slightly to the right relative to the head plate. This locking bar **174** has a series of six vertical notches **176**, **176** spaced along its length for association with each of the six testing devices **122**, **122**, respectively. With the shifting of the locking bar **174** to the right relative to the head plate **82**, its notches **176**, **176** will be aligned with the respective testing devices **122**, **122** so that the locking pins **128**, **128** on the various testing devices will drop through the notches **176**, **176** as the lift bar **134** is lowered. This permits the testing devices to be lowered into operative positions with respect to the bottles being gaged or inspected.

As has been described, the lifting bar will be elevated before the head plate **82** reaches the full extent of its right-hand travel and as the lifting bar is elevated it lifts the testing devices **122**, the locking pins **128**, **128** passing upwardly through the respective notches **176**, **176** in the horizontal locking bar. Then, when the head plate **82** reaches the full extent of its right-hand travel, the right-hand end of the locking bar will engage a stop **178**. Like the left-hand stop **175**, the right-hand stop **178** is mounted on the frame so that it is engaged by the right-hand end of the locking bar **174**, the said locking bar will be shifted to the left relative the head plate **82**. This causes the slots **176**, **176** in the said locking bar to move out of alignment with the respective testing devices **122**, **122**. Thus, when the lifting bar **134** is lowered during the right-hand to left-hand movement of the head plate **82**, the testing devices **122** will not be lowered because the locking pins **128**, **128** will engage the top of the locking bar **174** and prevent downward movement thereof.

As has been said, each inspection device **122** is lowered into engagement with a bottle B in order to inspect or gage it. The bottle will pass inspection if the tube **124** and sleeve **126** of the inspection device are both permitted to be lowered to a known elevation, and no more or no less, when the inspection device engages the bottle. In the event the bottle fails to pass inspection, an event causing either the tube **122** and/or the sleeve **126** not to reach their known elevations, an electrical switch is actuated to provide an electrical signal in circuitry which will store or memorize the signal so as to later operate a reject mechanism which will push the faulty bottle from the line on the conveyor.

There is one such reject signal switch provided for operative association with each testing or inspecting device **122**, and the series of six switches thus provided are mounted on the frame in the upper cabinet **18** for actuation by means on the passing testing devices which are carried by the moving head plate **82**. An example of such switch device is indicated generally by the reference number **180** in FIG. 9 and is seen to include a blade-like actuator or flag **182** which is pivotable on center point pins **184**, **184** but which is biased by a torsion spring **186** to the normal position shown in FIG. 9. That is, when the flag **182** is in the position shown, the switch **180** will not be closed to provide a reject signal, but when the flag is engaged by some means and pivoted from its normal position during the passing movement of the inspection device **122**, the switch **180** will be energized to cause the reject signal.

The means for engaging and moving the flag **182** from its normal position comprises two pins, one being the locking pin **128** on the tube **124** and the other being a pin **188** carried by the sleeve **126** of the inspection device **122**. Both of these pins project forwardly from the inspection device, and as shown in FIG. 9, when the inspection device is lowered into engagement with a bottle B to gage the same, and if the bottle passes inspection, the said pins will not engage and move the flag. That is, when the inner tube **124** is lowered to its proper known elevation as a result of engagement with a satisfactory bottle, the forwardly projecting end of the pin **128** will pass through a notch **190** on the flag. In the event the tube **124** cannot be lowered to the proper point, the pin **128** will engage the flag **182** above the notch **190** in the area designated **192**. In the event the tube **124** falls below the desired level, the pin **128** will strike an appendage **194** below the notch **190** to move the flag **182** and cause a reject signal. If the sleeve **126** is lowered to its proper elevation as shown in FIG. 9, its pin **188** will pass through a notch **196** in the rearward edge of the flag or blade **182**. If the sleeve does not reach its proper level, the pin will engage an appendage **198** over the notch **196**, and if the sleeve **126** falls below the desired level, the pin **188** will engage an appendage **200** on the flag **182** below the notch **196** and thereby also cause a reject signal. The causes or imperfections in the bottles preventing the tube and sleeve from reaching the desired points will be described hereinafter.

As mentioned previously, there are a series of six switches **180**, **180**, each of which is associated with a specific inspection device **122**. As was also previously mentioned, the inspection devices are lowered and raised

as they are being carried along from left to right by the head plate **82**. This movement could cause the actuating pins on one inspection device to actuate the wrong switch and cause a false reject signal if it were not for the timing and control of the inspecting device lifting bar **134**. For example, if it were not for the proper timing, the second from the left-hand inspecting device might engage and actuate the farthest left switch **180** as the head plate **82** moves from left to right carrying the inspecting devices **122, 122** with it. However, the timing of rotation of the crank **146** to rock the bell crank on the pivot **154** is such that the inspecting devices **122, 122** will not be lowered until they have passed the switch **180** which is to the left of the switch they are associated with, and the inspecting devices will be raised to clear the switches to the right of those with which they are associated. More specifically, the pin **128** on the tube **124** of one inspecting device **122** will pass over the flag or blade to the left of its associated switch while the pin **188** on the sleeve **126** will pass between the appendages **194** and **198**. They will likewise clear the flag **182** on the switch to the right of that with which they are associated. The dwell **156** in the rocking bell crank cam slot **150** is provided to hold the lift bar **134** up and to maintain the raised condition of the inspecting devices **122, 122** as the head plate reaches each end of its travel and thus to permit shifting of the locking bar **174**. The inspecting devices dwell in the down position due to engagement with the bottles.

It is to be understood that each inspecting device **122** can be fitted with various bottle engaging elements to inspect or gage each bottle B for a variety of dimensional defects. In the example shown, each inspecting device is provided with elements adapted to inspect a bottle for "choke," "corkage," and oversize "finish" around the neck opening, overheight and underheight, and for "leaners" or bottles which in some manner have their neck opening axes displaced from the axes of their bodies.

In adapting each inspecting device **122** for the foregoing tests, a probe **202** (FIG. 9) is secured to the bottom end of the inner tube **124** to be projected into the neck of a bottle B being tested when the inspecting device **122** is lowered. Also, a ring gage **204** (FIGS. 8 and 9) is secured to the bottom end of the sleeve **126** as by a generally C-shaped clamp **206** (FIG. 8) surrounding the bottom end of the sleeve and fitting in an annular groove **208** (FIG. 9) in the gage. The gage **204** is adapted to receive the top end portion or "finish" of the bottle surrounding the neck opening.

As shown in FIG. 9, a bottle B will pass inspection when its neck opening is sufficiently large to receive the probe **202** to the depth shown and not large enough to let the probe descend farther. That is, the bottle will have passed the "choke" test in permitting the probe to enter for the proper depth and it will have passed the "corkage" test in not permitting the probe to descend farther than shown. Further, the bottle will have passed the "leaner" or neck eccentricity test in that the neck opening will be properly located below the inspecting device **122** to receive the probe. The bottle will have also passed the finish examination in that the ring gage **204** will slip down over the finish surrounding the neck opening to the depth shown, and the bottle will have been found to be not too tall and not too short in permitting the inspecting device to lower to the position shown relative to its associated reject signal switch **180**.

After the inspection has been completed, the inspecting device **122** is lifted by the lift bar **134**. A hook-shaped stripper finger **210** is carried by the head plate **82** for each inspecting device. The end of this hook-shaped finger rides within a slot **212** in the ring gage **204** during vertical movement of the inspecting device relative to the head plate. If the inspecting device tends to lift the bottle B with it after performing the inspecting operation, the end of the stripper finger will engage the top edge of the bottle B and strip it from the inspecting device after the bottle has been raised only a very slight distance.

FIGS. 10 through 17 show many of the positions of an inspecting device **122** relative to its associated reject switch actuating plate or flag **182**. In FIG. 10, the inspecting device is shown in an elevated position wherein neither of its pins will engage and actuate the flag **182**. This position of the inspecting device relative to its flag is similar to its position in passing over an adjacent flag. It is also its position relative to all flags when the head plate is being moved from right to left.

In FIG. 11 the inspecting device **122** is shown engaged with a satisfactory bottle B. In such event, the upper pin **128** passes through the notch **190** and the lower pin **188** passes through the notch **196** in the flag **182** so that no reject signal will result. There will be no reject signal result either in the condition depicted in FIG. 12. In FIG. 12, the inspecting device **122** is shown lowered to the extreme end of its travel, an event which will occur if there is no bottle positioned to be inspected. In such event, the upper pin **128** passes below the appendage **194** and the lower pin **188** passes the bottom appendage **200**.

FIG. 13 shows the condition wherein a bottle fails to pass inspection because it is a "leaner" or for some other reason has its neck opening offset from the body. In such event, the ring gage **204** will engage the top edge or finish of the bottle and the probe **202** will also engage the top edge or finish of the bottle causing its pin **128** to engage the flag **182** in the area **192** and thereby move the flag to create a reject signal. The success of the "leaner" test is achieved because the rake **72** precisely locates the bottoms of the bottles relative to the overhead testing devices.

In FIG. 14 a "choke" condition is shown. That is, the bottle B fails to pass inspection because its neck opening is too small and the probe **202** cannot lower itself sufficiently within the bottle. Here again, the pin **128** engages the area **192** to actuate the reject signal switch.

FIG. 15 shows the condition existing upon detecting a "corkage" defect. In this case, the probe **202** is permitted to slip too far into the bottle due to an oversize neck opening, and this causes the pin **128** to engage the flag **182** at the appendage **194**.

In FIG. 16 there is shown the condition caused by a bottle having a "finish" which is too large to be properly capped. In this event, the ring gage **204** will not lower to its proper position, and its pin **188** will engage the flag **182** on the appendage **198**.

And finally, FIG. 17 shows the condition arising when a bottle is too tall. The ring gage **204** will not lower to its proper position and again its pin **188** will strike the projection **198**. If the bottle is too short, the ring gage **204** will fall too far downwardly and its pin **188** will engage the appendage **200**.

In the embodiment of the inspecting machine which has been shown and thus far described, there are a series of six bottles engaged simultaneously by the rake **72** as shown in FIG. 18 for inspection purposes. The machine can readily be adapted to inspect simultaneously a series of lesser number but of larger bottles B'. In such event, a rake **72*a*** can be used as shown in FIG. 19, the said rake having fewer bottle engaging notches therein. For example, and as shown in FIG. 19, the rake can be provided with three notches to engage a series of three bottles. In such event, it is only necessary to provide three inspecting devices **122, 122** and three switch actuating flags **182, 182**. It is not necessary to remove the unused inspecting devices from the machine. That is, the inspecting devices can still be carried back and forth by the head plate **82** but they can be held upwardly in inoperative position. More specifically, the unneeded inspecting devices are held upwardly and the locking pin **128** is thrust rearwardly to engage the top of the head plate **82** so that they cannot be lowered in the operation of the lifting bar. The unneeded inspecting devices can be restored to operation whenever needed

merely by pulling the locking pin forwardly to engage the detent pin **132** in the position shown in FIG. 9.

In the operation of the machine described, each of the reject signal switches **180, 180** is actuated by its flag **182** as a result of any one of a number of bottle defects which have been described. As mentioned, when a defect is noted and a reject signal is caused thereby, this signal is passed to conventional circuitry (not shown) wherein it is stored or memorized to later operate a reject mechanism. This reject mechanism is shown generally by the reference number **214** in FIGS. 1 and 2 and it is of conventional construction. As shown, the reject mechanism is located to the right of the upper cabinet **18**, and it includes a plunger which will be operated to push a defective bottle from the conveyor **16** as that defective bottle reaches a position opposite the reject mechanism. Preferably, the circuitry also includes means for operating a counter **216** (FIG. 1) which provides a total count of all containers inspected, and the circuitry can also operate a counter **218** which will show a total of defective or rejected bottles.

The bottles rejected may be defective for any one of several different reasons which have been mentioned. In some installations it may be desirable to note the reason for defect so that if the defect reoccurs frequently for the same reason corrective measures can be taken. In such event, a modified reject signal flag structure can be used, this structure being shown in FIG. 20. The modified flag structure utilizes a plurality of separate flags **220, 222, 224, 226** and **228**. It will be observed that the arrangement of these distinct flags is similar to the single flag **182** of the embodiment described and, therefore, these flags can be actuated by the same actuating pins **128** and **188** on the inspecting devices **122, 122**. However, each of the flags **220–228** is associated with a different switch, the switches being designated by the references **230–238**, respectively. Each of the said switches will serve to create the reject signal, but they can be included in circuitry which will operate counters (not shown) to show the number of defective bottles occurring for each of a number of reasons or defects. Thus, the flag and switch arrangement shown in FIG. 20 will often be preferred because of the discriminating information provided at the time of inspection.

The invention claimed is:

1. A machine for inspecting glass containers or the like and including a continuously moving conveyor for advancing a line of containers which are spaced apart and stand upright in the line, a drive mechanism and a head driven thereby to reciprocate in a single path longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, an inspecting device carried by the head and movable thereon into and out of engagement with a container on the conveyor to inspect the same, an element operated by said drive mechanism in timed relationship with said conveyor and head for lowering the inspecting device into engagement with a container and for lifting it out of engagement therewith only when the head is moving in the same direction as the conveyor, and a switch having an actuator supported on said machine for engagement and operation by said inspecting device only as a result of the inspecting device being at other than a predetermined elevation when engaging the container, whereby a signal is provided indicating the container is defective.

2. A machine for inspecting glass containers or the like and including a continuously moving conveyor for advancing a line of containers which are spaced apart and stand upright in the line, a drive mechanism and a head driven thereby to reciprocate longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, a series of inspecting devices carried by the head and movable thereon into and out of engagement with an equal series of containers on the conveyor to inspect the same, a driven element for simultaneously lowering the inspecting devices into engagement with the containers and for lifting them out of engagement therewith only when the head is moving in the same direction as the conveyor, and switch means having an equal series of actuators supported on said machine for engagement and operation, each by an associated inspecting device, only as a result of its associated inspecting device being at other than a predetermined elevation when engaging a container, whereby a signal is provided indicating the container is defective, the head being arranged to move opposite to the direction of the conveyor for repeated operation of the testing devices on the next equal series of containers in the line.

3. A machine for inspecting glass containers or the like and including a continuously moving conveyor for advancing a line of containers which are spaced apart and stand upright in the line, a drive mechanism and a head driven thereby to reciprocate in a single path longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, an inspecting device carried by the head and movable thereon into and out of engagement with a container on the conveyor to inspect the same, a container positioning mechanism driven by said drive mechanism to engage and position a container on the conveyor beneath the inspecting device only when said head is moved in the direction of the conveyor, an element operated by said drive mechanism in timed relationship with said conveyor and head for lowering the inspecting device into engagement with a container so positioned to inspect the same and for lifting it out of engagement while the head is moved in the direction of the conveyor, and a switch having an actuator supported on said machine for engagement and operation by said inspecting device as a result of the inspecting device being at other than a predetermined elevation when engaging the container, whereby a signal is provided to indicate the container is defective.

4. A machine for inspecting glass containers or the like and including a continuously moving conveyor for advancing a line of containers which are spaced apart and stand upright in the line, a drive mechanism and a head driven thereby to reciprocate in a single path longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, a series of inspecting devices carried by the head and movable thereon into and out of engagement with an equal series of containers on the conveyor to inspect the same, a container positioning mechanism driven by said drive mechanism to engage and position an equal series of containers on the conveyor beneath the series of inspecting devices only when said head is moved in the direction of the conveyor, an element operated by said drive mechanism in timed relationship with said conveyor and head for simultaneously lowering the inspecting devices into engagement with the containers so positioned and for lifting them out of engagement while the head is moved in the direction of the conveyor, and switch means having an equal series of actuators supported on said machine for engagement and operation, each by an associated inspecting device, as a result of its associated inspecting device being at other than a predetermined elevation when engaging a container, whereby a signal is provided indicating the container is defective, the head being arranged to move opposite to the direction of the conveyor for repeated operation of the testing devices on the next equal series of containers in the line.

5. A machine for inspecting glass containers or the like including a drive mechanism, a driven conveyor for advancing a line of upright containers, a driven feed mechanism for engaging and spacing the containers in the line, a head driven to reciprocate in a single path longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, an inspecting device carried by the head and

movable thereon into and out of engagement with a container on the conveyor to inspect the same, a container positioning mechanism operable by said drive mechanism to engage and position a container on the conveyor beneath the inspecting device only when said head is moved in the direction of the conveyor, an element operated by said drive mechanism in timed relationship with said conveyor and head for lowering the inspecting device into engagement with a container so positioned and for lifting it out of engagement while the head is moved in the direction of the conveyor, and a switch having an actuator supported on said machine for engagement and operation by said inspecting device as a result of the inspecting device being at other than a predetermined elevation when engaging the container, whereby a signal is provided to indicate the container is defective.

6. A machine for inspecting glass containers or the like including a drive mechanism, a driven conveyor for advancing a line of upright containers, a driven feed mechanism for engaging and spacing the containers in the line, a head driven to reciprocate in a single path longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, a series of inspecting devices carried by the head and movable thereon into and out of engagement with an equal series of containers on the conveyor to inspect the same, a driven container positioning mechanism carried by said head and operated to engage and position an equal series of containers on the conveyor beneath the series of inspecting devices only when the head is moved in the direction of the conveyor, an element operated by said drive mechanism in timed relationship with said conveyor and head for simultaneously lowering the inspecting devices into engagement with the containers so positioned and for lifting them out of engagement while the head is moved in the direction of the conveyor, and switch means having an equal series of actuators supported on said machine for engagement and operation, each by an associated inspecting device, as a result of its associated inspecting device being at other than a predetermined elevation when engaging a container, whereby a signal is provided indicating the container is defective, the head being arranged to move opposite to the conveyor for repeated operation of the testing devices on the next equal series of containers in the line.

7. A container inspecting machine as set forth in claim **6** wherein said driven feed mechanism includes a rotatable worm engaging containers between its convolutions to space the containers apart in the line while permitting them to advance with the conveyor.

8. A machine for inspecting glass containers or the like including a drive mechanism, a driven conveyor for advancing a line of containers which are spaced apart and stand upright in the line, a head driven to reciprocate longitudinally of and over the conveyor and at substantially equal speed therewith when moving in the same direction, a series of inspecting devices carried by the head and movable thereon downwardly and upwardly into and out of engagement with an equal series of containers on the conveyor to inspect the same, a driven lift bar operable downwardly and upwardly for simultaneously lowering and raising the inspecting devices on the head, the said lift bar being so operable as the head moves with and also as the head moves opposite to the conveyor, means carried by the head and operable automatically when the head has completed its movement with the conveyor to prevent lowering of the inspecting devices as the head moves opposite to the conveyor, the said means also being operable automatically when the head has completed movement opposite the conveyor to permit lowering and raising of the inspecting devices when the head moves with the conveyor, and switch means having an equal series of actuators supported on said machine for engagement and operation, each by an associated inspecting device, only as a result of its associated inspecting device being at other than a predetermined elevation when engaging a container, whereby a signal is provided indicating the container is defective, the head being arranged to move opposite to the conveyor for repeated operation of the testing devices on the next equal series of containers in the line.

9. A container inspecting machine as set forth in claim **8** wherein the automatically operable means carried by the head comprises a locking bar engageable with the machine as the head completes movement with and opposite to the conveyor, whereby to shift its position respectively to lock and to unlock the inspecting devices in raised positions.

10. In a machine for inspecting glass containers or the like and which includes a head movable with a container being advanced in an upright position, an improved inspecting device carried by the head for substantially vertical movement downwardly and upwardly into and out of engagement with the container to inspect the same, the said inspecting device comprising a probe, a slotted sleeve telescopically receiving the probe and having means engageable with the container finish around its opening to permit entry of the probe into the opening, a switch having an actuator supported on the machine adjacent the path of the advancing container, a pin carried by said probe and projecting through the slotted sleeve, and a pin carried by said sleeve, both of said pins being arranged independently to engage and operate said actuator if its associated probe or sleeve is at other than a predetermined elevation when the inspecting device engages the container, whereby a signal is provided indicating that the inspected container is defective.

11. In a machine for inspecting glass containers or the like which are being advanced in an upright position and wherein the machine includes an inspection head having a plate for carrying an inspection device for vertical movement downwardly and upwardly into and out of engagement with a container as the head moves along therewith, an improved inspecting device comprising a probe, a slotted sleeve telescopically receiving the probe and which has means engageable with the container finish around its opening to permit entry of the probe into the opening, a switch having an actuator supported by the machine adjacent the path of the containers, a pin on the probe projecting through the slotted sleeve, and a pin on the sleeve projecting in the direction of the probe pin so that either of said pins will engage and operate said switch actuator if the associated probe or sleeve is at other than a predetermined elevation when the inspecting device engages a container to provide a signal indicating that the container is defective, and the pin on the probe being manually operable to be engaged with the head plate to retain the inspecting device in an elevated inoperative position.

12. The improvement in a container inspecting machine as set forth in claim **11** wherein said switch actuator comprises a notched pivotable flag, the notches in the flag being arranged to permit free passage of the pins when the inspecting device is elevated and when the probe and sleeve are disposed at their predetermined elevations with the inspecting device engaging a container.

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