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WASTE GLASS BOTTLE COLOR-CLASSIFICATION METHOD AND APPARATUS OF THE SAME

FIELD OF THE INVENTION

5 The invention relates to a waste glass bottle color-classification apparatus for classifying waste glass bottles in color, more particularly to a waste glass bottle color-classification apparatus and a classification method of the same for recycling the bottles as resources. The apparatus has a bucket conveyor for automatically classifying waste glass bottles in
10 color and selectively has a device for precluding bottles standing in the buckets.

BACKGROUND OF THE INVENTION

FIG. 13 is a diagrammatic illustration showing a known waste glass bottle color-classification apparatus. In the figure, there is provided a
15 roller conveyor 10 for classifying waste glass bottles in size. The conveyor includes a couple of chains between which a lot of rotatable rollers 10a are disposed to be connected to the chains. Each space between a couple of adjacent rollers 10a is widened gradually in the advancing direction of the conveyor, which can classify waste glass bottles 11 in size based on main
20 body diameters of the bottles.

First, waste glass bottles 11 are supplied on roller conveyor 10 to be classified in size. The classified bottles 11 are orientated in its longitudinal direction to form a line by an orientating means 2, and then are moved on a bucket conveyor 3 positioned downstream from orientating means 2.
25 Bucket conveyor 3 is provided with such buckets 31 as shown in FIG. 14. Each waste glass bottle 11 on buckets 31 is discriminated in color by a color discrimination apparatus 5 and the number of the bucket having



the bottle is recognized at the same time.

An image obtained by optically sensing each glass bottle 11 in the longitudinal direction of the bottle, that is, from the spout side or from the bottom side of the bottle is processed to discriminate the bottle color. Waste glass bottle 11 is further moved toward a delivery chute 6 by bucket conveyor 3. When each bucket 31 reaches delivery chute 6 corresponding to the bottle color determined by color discrimination means 5, which can be known by the bucket number, a bottom plate 32 of the bucket 31 is opened to classify bottles 11 in color.

In addition, for discriminating colorless glass bottles, bottle color discrimination means 5 determines based on whether the background color at the optically sensing point for the bottles is consistent with the sensed color of the bottle. Meanwhile, in an empty bucket with no bottle, bottle color discrimination means 5 determines that the sensed color is in consistent with the background color, which causing the bottom plate of the empty bucket to open at the delivery chute for receiving colorless waste glass bottles.

The known classification apparatus has another disadvantage described hereinafter. Waste glass bottles recycled as resources are disposed in a very fragile condition due to the mutual abutting of bottles which are in an uneven state during the gathering thereof. Accordingly, the classification means mostly receives waste glass bottles that include cullets (fragmented glass bottles). Smaller ones of the cullets can be precluded in an upstream side from the bottle orientating means by the aforementioned roller conveyor for bottle classification in size. However, since there are numerous types of cullets in size and furthermore the bottles themselves are different in size or in length, the classification means



can not preclude completely the cullets, causing the remained cullets to be supplied into the bottle orientating means. Moreover, some of the bottles may be broken after passing the bottle in-size classification means. Thus, the known waste glass bottle color-classification apparatus has the disadvantage that these cullets are transferred to the bucket conveyor together with complete bottles to be received in the delivery chute 6.

In the known waste glass bottle color-classification apparatus, there are three types of bucket load conditions when the buckets pass the bottle color discrimination means, which include a bottle transferring condition, no load condition, and a cullet transferring condition. With regard to the bucket in the bottle transferring condition, the bottle color discrimination means can correctly discriminate the color of each glass bottle based on sensed signals to classify the bottles. However, in the cullet load condition, there is a possibility that the load condition is be incorrectly determined. Particularly, when a flat cullet is disposed along an inner surface of a bucket, the bottle color discrimination means can not obtain an output sufficient for color determination, since the optically sensing for the object in each bucket is carried out horizontally from a lateral side of the bucket in a perpendicular direction to the bucket transfer direction so that the optically sensing area of the flat cullet is small. For this disadvantage, the bottle color discrimination means may determine a bucket having a cullet to be an empty bucket. Accordingly, the bottom plate of a bucket having a colored cullet is possibly opened at a delivery chute for colorless bottles so that colored cullets may be mixed into colorless recovered bottles to disadvantageously decrease the purity of the colorless bottles.

The known waste glass bottle color-classification apparatus has a further disadvantage described hereinafter. In the known classification

apparatus, the orientating means 2 orientates the bottles 11 to form a line in the its longitudinal direction. Then, the bottles are moved into the bucket conveyor 3 traveling in a perpendicular direction to the advancing direction of the orientating means 2. Each bucket 31 mounted on bucket conveyor 3, as shown in FIG. 10, has an upwardly opened configuration.

Accordingly, when transferring a waste glass bottle 11 into a bucket 31 on the bucket conveyor 3 is good in timing, the bottle 11 can be positively received in the bucket 31 with the bottle being in a laid position. However, a bad timing causes bottle 11 to abut against an upper inner wall of the bucket, which makes the bottle stand in the bucket 31 occasionally. Such standing bottles, as illustrated by waste glass bottles 11a, 11b in FIG. 10, are mostly positioned with their spouts being directed upward and their bottoms downward. A color discrimination apparatus 5 disposed to be consistent with the height of the bucket conveyor 3 can optically sense the color of the laid bottle 11 in the bucket 31 in the bottle longitudinal direction, that is, toward the spout or bottom of the bottle. Meanwhile, the above-mentioned standing bottle in the bucket 31 is optically sensed at the bottle main body for color-discrimination. The bottle main body has a thin glass thickness, which is disadvantageous for recognition of color, possibly causing that a colored glass bottle is determined to be a colorless transparent bottle. In addition, on the bottle main body is affixed one of variously colored labels. Thus, the standing bottle may be wrongly determined in color discrimination due to the label on the main body. Moreover, the standing bottle transferred by the bucket may abut against the color discrimination means 5 disposed in alignment with the middle height of the bucket conveyor 3 or against a cover for a sprocket wheel 36



of bucket conveyor 3 or etc. Accordingly, there is a possibility of a serious damage in the apparatus.

SUMMARY OF THE INVENTION

5 In view of the aforementioned disadvantages, an object of the invention is to provide a waste glass bottle color-classification method and an apparatus of the same, which can prevent the decrease of purity degree in color with regard to recovered waste glass bottles by sensing the bottle load condition of each bucket.

10 Another object of the invention is to provide a waste glass bottle color-classification apparatus that can classify waste glass bottles in a high degree of purity in color.

Considering the aforementioned disadvantages, in a first configuration of the invention, a waste glass bottle color-classification method comprising the steps of:

15 feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

sensing the load condition of the bucket,

optically sensing the waste glass bottle in the bucket to discriminate the bottle color,

20 discharging the waste glass bottle having been determined in color into a delivery chute corresponding to the determined color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining
25 bottles that have not been discriminated in color.

That is, since there may be colored cullets in a bucket that is determined to be in no load condition at the step for sensing the bucket



load condition, the bottom plate of the bucket that has been determined to be in no load condition is opened at the delivery chute for receiving the remaining bottles that have not been discriminated in color. This prevents colored cullets from getting mixed with colorless transparent bottles.

5 In a second configuration of the invention, a waste glass bottle color-classification method comprising the steps of:

feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

10 optically sensing the inside of the bucket by a bottle detecting sensor to determine the load condition of the bucket,

sensing only the bucket that has been determined to be in a bottle loaded condition to discriminate the bottle color,

discharging the discriminated bottle into a delivery chute corresponding to the bottle color to classify the bottle, and

15 opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining bottles that have not been discriminated in color.

That is, only the buckets that have been determined to be in a bottle loading condition are discriminated in color of the loaded bottles. Meanwhile,
20 the bottom plate of a bucket that is determined to be in no load condition is opened at the delivery chute for receiving the remaining bottles, preventing colored cullets from getting mixed with colorless transparent bottles. This can eliminate one of the disadvantages described in the known bottle classification apparatus.

25 In a third configuration of the invention, a waste glass bottle color-classification apparatus comprising:

a bucket conveyor having a plurality of buckets each with an openable

bottom plate and transferring waste glass bottles supplied in the buckets,

a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color,

5 a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color,

a bucket sensor for sensing the pass of the bucket on the conveyor, and

10 a load condition determination means for sensing the load condition of each bucket on the conveyor,

wherein the load condition determination means can output a signal indicating the empty condition of a bucket so as to open a bottom plate of the bucket at the chute for receiving the remaining bottles.

15 The load condition determination means may be a type of known various devises for sensing the inside of the bucket. The determination means can control an empty bucket to open its bottom plate at the chute for receiving the remaining bottles because the empty bucket may have a cullet yet. This prevents colored cullets from getting mixed with classified colorless transparent bottles.

20 In a fourth configuration of the invention, a waste glass bottle color-classification apparatus comprising:

(a) a bottle orientating means for orientating each waste glass bottle in its longitudinal direction,

25 (b) a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles each supplied in one of the buckets from the bottle orientating means in a perpendicular direction to the longitudinal direction of the bottle,



(c) a bottle color discrimination means for sensing the color of each waste glass bottle supplied in the bucket on the conveyor,

(d) a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, the chutes being positioned downstream from the bottle color discrimination means and under the bucket conveyor,

(e) a bottle detecting sensor for determining the presence or absence of a waste glass bottle in the bucket,

(f) a bucket sensor for generating a signal to measure a timing when each bucket on the conveyor passes a relative predetermined point,

(g) a control means for classifying in color each bottle transferred by the bucket conveyor based on outputs each from the bottle detecting sensor, the bottle color discrimination means, and the bucket sensor, the control means generating a control signal to open both a bottom plate of the bucket which has been determined to be in no load condition by the bottle detecting sensor and a bottom plate of the bucket which can not be discriminated in color at the delivery chute for receiving the remaining bottles.

Thus, based on information from each sensor, the control means can open the bottom plate of the bucket that may have colored cullets at the delivery chute for receiving the remaining bottles, which advantageously preventing colored cullets from getting mixed with classified colorless transparent bottles.

In a fifth configuration of the invention, the apparatus as claimed in the third configuration of the invention further includes that the bottle color discrimination means disposed in the upper stream of the bucket



conveyor can optically sense the inside of the bucket to detect the color of each bottle in synchronization with the pass of the bucket having a bottle with using a trigger timing signal that is obtained from a product of a detected signal of the bottle detecting sensor and a detected signal of the bucket sensor.

In a sixth configuration of the invention, the apparatus as claimed in the fourth configuration of the invention further includes that the control means comprises:

a load condition determination means for determining the load condition of the bucket based on a signal sensed by the bottle detecting sensor,

a bucket detection signal generating means for generating a bucket detection signal based on a signal sensed by the bucket sensor during the pass of the bucket,

an optically sensing timing signal generating means for generating a timing signal based on a product of outputs from both the bucket detection signal generating means and the load condition determination means,

a color discrimination signal generating means for discriminating the color of the bottle based on an output from the bottle color discrimination means, and

a classification control signal generating means for receiving signals supplied from the bucket detection signal generating means to generate a control signal for opening a bottom plate of a bucket carrying a bottle having a predetermined color and of a bucket carrying no bottle respectively at the corresponding delivery chute.

Next, the above-mentioned waste glass bottle color-classification apparatus according to the present invention will be further discussed.



Waste glass bottles that are usually supplied in a random position are orientated to form a line with their longitudinal axes being directed in the advancing direction by an orientating means. Thereafter, the bottles are moved into the bucket conveyor. The buckets carrying the bottles advance downstream on the conveyor to reach a point A and/or B (shown in FIG. 1) where the bottle detecting sensor (or a load condition sensing means)senses the bucket for determining the bottle load condition. Furthermore, the bottle color discrimination means disposed at a further downstream point optically senses the bottle in the bucket. Thus obtained images are processed to discriminate the bottle color. The optical sensing for the bottle in the bucket by the bottle color discrimination means is operated based on the timing of an output signal supplied from the bucket sensor disposed at a point E (shown in FIG. 1). That is, optically sensing the bottle in the bucket based on the signal output timing of the bucket sensor allows the optical sensing to be adequately operated.

Furthermore, in the present invention, using the product of the output signal from the bucket sensor and the output signal from the bottle detecting sensor as a trigger for the optically sensing timing of the bottle enables to sense only the buckets carrying a bottle for color discrimination. Thus, it is not necessary to optically sense all the buckets for image processing. That is, based on the output signal from the bottle detecting sensor, optically sensing of the bottle is selectively operated, which improves a throughput speed of the apparatus.

However, after the insides of all the buckets are optically sensed based on the output timing of the bucket sensor, the bottle detecting sensor may sense the bottle loaded condition of the bucket. In this case, only the obtained images of the bucket carrying a bottle are processed for color



discrimination. The bottom plate of the bucket that is determined to be in a bottle loaded condition by the bottle detecting sensor is opened at the delivery chute corresponding to the color determined by the color discrimination. Meanwhile, with respect to the bucket that is determined to be in an empty condition by the bottle detecting sensor, no image processing for color discrimination is operated in any of the foregoing cases. In addition, the bottom plate of the empty bucket is intentionally opened at of the delivery chute for receiving the remaining ones, so that colored cullets are controlled not to get mixed into delivery chutes for receiving colored bottles. Thus modified classification control method can prevent a decrease in the degree of color purity of the sorted glass bottles. It is easy to modify the control means for altering the classification control. Meanwhile, the bucket sensor may be disposed with little restriction, because the function of the sensor is only to know the timing of the pass of the bucket at a predetermined point.

Alternatively, the bottle color discrimination means optically senses all the buckets so that all the obtained images are processed for color discrimination. Furthermore, in the classification step, based on the measurement results of the bottle detecting sensor, the bucket that has been determined to be in a bottle loaded condition is opened at the delivery chute corresponding to the discriminated color of the bottle, and the bucket that has been determined to be in no load condition is opened at the delivery chute for receiving the remaining ones. This achieves the same effect as the aforementioned method. In addition, the bottle detecting sensor may be disposed at one of points A, B, C, and D positioned upstream from the delivery chute (see FIG. 1).

A furthermore object of the invention is to provide a waste glass bottle



color-classification apparatus that can preclude standing bottles in the buckets. This can eliminate a wrong determination when the bottles in buckets transferred by a bucket conveyor are discriminated in color, allowing an improvement in the degree of color purity of classified glass bottles and preventing the apparatus from being damaged by the standing bottles, resulted in an improved availability of the apparatus.

For achieving the object, in a seventh configuration of the invention, a waste glass bottle color-classification apparatus comprising:

a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and

a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

wherein the presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery chute, and the color of a bottle that has not been determined to be a standing one is discriminated in color so that the bottle is classified to be discharged into a delivery chute corresponding to the color of the bottle.

In this apparatus, the standing bottles are recovered into the standing bottle delivery chute and the bottles are recovered separately in color with a high degree of purity in color of bottle.

In an eighth configuration of the invention, in addition to the seventh configuration, the apparatus further includes that the standing bottle having been discharged into the delivery chute is circulated by feeding the



bottle on the bottle orientating means again.

In a ninth configuration of the invention, a waste glass bottle color-classification apparatus comprising:

5 (a) a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle,

(b) a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an
10 openable bottom plate,

(c) a bottle color discrimination means for discriminating the color of a bottle mounted on each bucket on the conveyor,

(d) a plurality of delivery chutes disposed downstream from the bottle color discrimination means and under the bucket conveyor, each
15 chute corresponding to each one of predetermined colors,

(e) a standing bottle removal means for precluding a bottle in one of the buckets,

(f) a bucket sensor for sensing the timing of the pass of each bucket on the conveyor, and

20 (g) a separation means for discharging each bottle transferred by the bucket conveyor into the delivery chute corresponding to the bottle color.

This configuration has the standing bottle removal means for precluding standing bottles that may possibly be wrongly determined in the
25 color discrimination, preventing such bottles from getting mixed with bottles different in color to improve the purity degree in color of classified bottles.



In a tenth configuration of the invention, in addition to the ninth configuration, the standing bottle removal means comprises:

(a) a standing bottle detecting sensor for sensing each transferred bottle to determine whether the bottle is standing in the bucket in an upstream side of the bottle color discrimination means,

(b) a standing bottle delivery chute positioned on the way from the standing bottle detecting sensor to the color discrimination means and under the bucket conveyor,

(c) a standing bottle removal means for discharging the standing bottle in the standing bottle delivery chute.

In this configuration, upwardly protruding bottles in the buckets are sensed by the standing bottle detecting sensor, so that the bottom plates of the buckets carrying the standing bottles is opened to preclude the standing bottles in the standing bottle delivery chute.

In an eleventh configuration of the invention, in addition to the ninth configuration, the standing bottle removal means can determine each bucket whether the bucket has a standing bottle based on both an output signal of the standing bottle detecting sensor and an output signal of the bucket sensor, and also can discharge the bottle into the standing bottle delivery chute by opening the bottom plates of the determined bucket and also by opening the bottom plates of a couple of buckets each positioned backward or forward adjacent to the determined bucket. This configuration can positively preclude such standing bottles.

In a twelfth configuration of the invention, in addition to the tenth configuration, the apparatus further includes that the standing bottle delivery chute has a container for receiving and storing the removed bottles or has a circulation device for returning the removed bottles



upstream from the bottle orientating means. In this configuration, the standing bottles can be classified in color again by returning the bottles in an upstream side from the bottle orientating means.

5

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic plan view showing a first embodiment of a waste glass bottle color-classification apparatus according to the present invention, which includes a control system;

10 FIG. 2A is a plan view of an orientating means in the first embodiment, and FIG. 2B is a sectional view taken along line A-A' in FIG. 2A;

FIG. 3 is a plan view showing a bucket conveyor in the first embodiment;

15 FIG. 4 is a side view showing the bucket conveyor in the first embodiment;

FIG. 5 is a sectional view showing the bucket conveyor in the first embodiment;

FIG. 6 is a timing diagram of outputs of sensors used in the embodiment and the related operations for classification;

20 FIG. 7 is another timing diagram of outputs of the sensors used in the embodiment and the related operations for classification;

FIG. 8 is a flow chart showing a control flow in a waste glass bottle color discrimination method according to the first embodiment;

25 FIG. 9 is a schematic plan view showing a second embodiment of the present invention;

FIG. 10 is an illustration for showing standing bottle loaded conditions related to the second embodiment;



FIG. 11 is a control flow related to the second embodiment;

FIG. 12 is a plan view showing a modified example of the second embodiment;

FIG. 13 is a schematic plan view showing a known classification apparatus; and

FIG. 14 is an illustration showing standing bottle loaded conditions related to the known classification apparatus.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A first embodiment

Referring to the accompanied drawings, embodiments of the waste glass bottle color-classification apparatus according to the present invention will be discussed hereinafter.

FIG. 1 is a diagrammatic illustration of an embodiment of a waste glass bottle color-classification apparatus according to the invention. The waste glass bottle color-classification apparatus includes an orientating conveyor 2 for orientating and transferring waste glass bottles 10 successively supplied from a bottle feeding conveyor 1 with the longitudinal direction of each bottle being in the conveyor advancing direction, a bucket conveyor 3 for receiving one by one the bottles 10 supplied from orientating conveyor 2 in its buckets, a bottle detecting sensor 4 for sensing the load condition of each bucket in respect of waste glass bottles 10, a bottle color discrimination means 5 for optically sensing waste glass bottle 10 in the bucket to discriminate the bottle color, a plurality of delivery chutes 6 for receiving bottles 10 separately in color, one of the chutes receiving the remaining bottles that can not be discriminated in color, a bucket sensor 7 for sensing its identification



number, and a control means 9 having a storage device 9g for memorizing the bucket load condition including bottle carrying conditions/no load condition of each bucket, and the discriminated color of the bottle together with the bucket identification number.

5 FIG. 2A is a plan view showing orientating conveyor 2 in the embodiment and FIG. 2B is a sectional view taken on line A—A' in FIG. 2A. The orientating conveyor 2 consists primarily of a conveyor 21 and a transfer guide 22. In the figures, θ denotes an inclination angle of conveyor 21 to a horizontal line. The angle θ is about 20° in the
10 embodiment. α denotes an angle of the operation direction of transfer guide 22 to the traveling direction of conveyor 21 and is set at an angle of about 10° . β denotes an angle between conveyor 21 and transfer guide 22. The angle β is set at an angle of about 90° .

15 With the traveling of conveyor 21, bottles 10 are moved toward the lower side of conveyor 21 so that the spout portion or the bottom portion of bottle 10 makes contact with transfer guide 22. Since bottle 10 is in contact both with conveyor 21 and transfer guide 22 and transfer guide 22 is higher than conveyor 21 in operating speed, the spout portion or the bottom portion of bottle 10 is forcibly turned to orientate in the operating direction
20 of transfer guide 22.

25 A main body portion of bottle 10 finally makes contact with the running guide 22, so that a main body side surface of bottle 10 orientates in the advance direction X_1 of running guide 22 to complete the orientation of bottle 10. In this embodiment, transfer conveyor 21 transfers in the direction of an arrow Y_1 , and running guide 22 transfers at a speed greater than in transfer conveyor 21. This can orientate and transfer at a high speed bottle 10 supplied on transfer conveyor 21, greatly decreasing



the mutual abutment of the bottles. Thus, the breakage and noise caused by the abutment of the bottles can be decreased and the orientation of a high rate can be achieved.

Next, referring to FIGS. 3 to 5, an example of bucket conveyor 3 will be discussed. FIG. 3 is a plan view of the conveyor, which includes a control system thereof; FIG. 4 a side view; and FIG. 5 is an enlarged sectional view of the buckets of the conveyor. In FIGS. 3 and 4, bucket conveyor 3 has buckets 31 disposed at regular intervals and provided with bottles 10. The buckets 31 are mutually connected by chains 33 that engage with a sprocket wheel 36. The sprocket wheel 36 drives chains 33 to move buckets 31. Each bucket 31 is formed to receive one of the bottles in a perpendicular direction to the advance direction and has an openable bottom plate 32.

The bottom plate 32 of bucket 31, as shown in FIG. 5, is released based on a control signal supplied from a control means 9. In operation, an air cylinder 35 operates based on the control signal, upwardly moving the roller 39 to pivot a hooking piece 38 for the bottom plate in the direction of an arrow so as to release a free end of bottom plate 32 from hooking piece 38 by the force of a spring 40 connected both to a wall surface of bottom plate 32 and a wall surface of bucket 31. The released bottom plate 32 is upwardly moved to close again by a rail 37 provided at the forward end of the conveyor with the advancing of bucket 31.

Furthermore, bucket conveyor 3 has a bottle detecting sensor 4 for sensing each load condition of buckets 31 at an upstream point A (FIG. 1) of bucket conveyor 3, and has a bottle color discrimination means 5 including a CCD camera for sensing the inside of the bucket at a downstream point F the point (FIG. 1). At a further point E (FIG. 1) is



disposed a bucket sensor 7. The bottle detecting sensor 4 can detect the load condition of bucket 31 in respect of a waste glass bottle. Bucket sensor 7 outputs a bucket detection signal when each bucket 31 pass a detection point. The bottle color discrimination means 5 identifies the color of bottle 10 mounted on each bucket 31 to output a corresponding color detection signal. The detection signals are received in the control means 9 that outputs control signals for classifying the bottles.

The classification of the waste glass bottles is based on control signals supplied from control means 9, which selectively operates the air cylinders 35 to open bottom plates 32 of buckets 31.

Waste glass bottles 10 are classified to be received in delivery chutes 6a to 6d based on the color of each bottle, and cullets are delivered into a delivery chute 6e for receiving the others. There are three types of load conditions of the buckets, which are a waste glass bottle loaded condition, no bottle loaded condition, and a cullet loaded condition. Bottle detecting sensor 4 can sense whether each bucket 32 is a bottle loaded condition or not. For bottle detecting sensor 4 is applied, for example, a reflector type optical sensor. Alternatively, a transmission optical sensor, a photoelectric switch, or an ultrasonic sensor may be used for sensing the presence or absence of a bottle 10 in each bucket 31. In addition, a plurality of sensors may be operably combined to sense the load condition of bucket 31.

Bucket sensor 7 is a position sensor for determining the position of each bucket 31. The bucket sensor generates a signal indicating the passing of each bucket, the signals being counted to determine the position of the bucket. For bucket sensor 7 is applied an optical sensor, but a proximity switch may be used if the bucket is made of metal. In addition, when an



optical sensor is utilized, a reflecting tape may be put on a side surface of bucket 31, which provides an intensified reflected ray when the tape cross the front face of the optical sensor, allowing the detection of the passing of the bucket. Alternatively, an encoder may be applied for detecting the passing timing of the bucket.

Control means 9 consists of both a signal processing means including an image processing means and a CPU (central processing unit). Output from bottle detecting sensor 4 is supplied to control means 9 so that a loaded condition determination means 9a determines whether the bucket is in a bottle loaded condition or in no bottle loaded condition including a cullet loaded condition. Pictures taken by bottle color discrimination means 5 are image-processed to discriminate the bottle colors. The discrimination results are supplied to a color indication signal generating means 9B to output color indicating signals. In addition, bottle color discrimination means 5 operates synchronously with timing signals supplied from a sensing timing signal generating means 9c. The count means 9d can count the bucket passing signals supplied from bucket sensor 7. A delivery position determination means 9e combines a color indicating signal supplied from color discrimination signal generating means 9b with a related counted value by supplied by count means 9d to determine which one of air cylinders 35 will be operated. Storage means 9g stores in memory each bucket number, the corresponding bottle color, and the corresponding load condition. The bottles are classified based on the data stored in storage means 9g. When each bucket passes one of predetermined points, the classification codes of the related delivery chutes are compared with the corresponding data stored in storage means 9g. If the codes match the data, the classification control signal generating means 9f outputs a control



signal to release bottom plate 32 of the bucket. Control means 9, for example, operates based on a control flow in a flow chart shown in FIG. 8.

Next, referring FIGS. 6 to 8, discrimination in color of the waste glass bottles and classification in load condition of the buckets with respect to the embodiment will be discussed in details.

FIGS. 6 and 7 are respectively a timing diagram showing an operation of the bottle color discrimination means.

The timing diagrams include the timing of the classification of the bottles. The classification separately delivers the bottles into a plurality of delivery chutes organized according to color or another delivery chute called by the code name of the others. In the timing diagram, load conditions of the buckets are classified into a waste glass bottle loaded condition, no load condition, and a cullet loaded condition.

In FIG. 6, item (a) denotes outputs of the bottle detecting sensor 4 positioned at point A. The sensor outputs a high level signal as corresponded to a bottle loaded condition of the bucket and outputs a low level signal as corresponded to no load condition or a cullets loaded condition of the bucket. The output of the bottle detecting sensor 4 is supplied to control means 9.

Item (b) in FIG. 6 denotes output waveforms of bucket sensor 7. When every bucket 31 moved by bucket conveyor 3 passes at a predetermined point, the bucket sensor outputs a pulse of a high level to input it into control means 9.

Item (c) in FIG. 6 denotes output waveforms of timing signals created by the products of outputs from bottle detecting sensor 4 and from bucket sensor 7 synchronously with outputs of bucket sensor 7 control means 9 creates the timing signals that are triggers to operate bottle color discrimination means 5.



Item (d) in FIG. 6 shows conditions of color indicating signals of color discrimination signal generating means 9b. When the bucket is determined to be in a bottle loaded condition based on an output of bottle detecting sensor 4, the bottle color discrimination means 5 senses the bottle synchronously with the timing signal to discriminate the bottle color. When the bucket is determined to be in no load condition or in a cullet loaded condition, no picture will not be taken. Bottle color discrimination means 5 outputs signals into color discrimination signal generating means 9b to determine the color of the bottle in the bucket.

In item (e) of in FIG. 6, when the bucket is determined to be in a waste glass bottle loaded condition, bottom plate 32 of bucket 31 is released at a delivery chute 6 corresponding to the determined color of the bottle to classify the bottle to be received in delivery chute 6. For no load condition, bottom plate 32 of bucket 31 is released at delivery chute 6e of the others code. For a cullet loaded condition, like no load condition, the bottom plate of the bucket is released at delivery chute 6e of the others code to classify the cullets.

In a timing diagram of FIG. 7, item (a) illustrates outputs of bucket sensor 7; and item (b) illustrates timing signals synchronized with outputs of bucket sensor 7. Bottle color discrimination means 5 senses all the buckets synchronously with the timing signals to discriminate the bottles. In item (c), color discrimination signal generating means 9b indicates a color signal based on outputs of bottle color discrimination means 5, but no load conditions and a cullet loaded conditions are determined as the same condition as a colorless bottle loaded condition. Item (d) shows outputs of bottle detecting sensor 4, which indicates a bottle loaded condition or no load condition including a cullet loaded condition. When the output of the bottle



detecting sensor is high in level, the bottle is delivered into a delivery chute 6 according to the color based on the output in item (c). Meanwhile, when the output of the bottle detecting sensor is low in level, the bucket is opened at the chute for the bucket of others code with disregarding the output in item (c).

Next, referring a flow chart of FIG. 8, a classification control flow of the bottles will be discussed. One of waste glass bottles is received one by one in each bucket on bucket conveyor 3 driven to transfer bottles (step S1). bucket sensor 7 senses every passing of bucket 31 to output a detection signal (step S2). Bottle detecting sensor 4 senses the load condition of each bucket 31 (step S3). Based on outputs of bottle detecting sensor 4, when bucket 31 is determined to be mounted with a waste glass bottle, the bottle in bucket 31 is sensed to discriminate the bottle color (step S4). Storage means 9g stores both the load condition and the color of the bottle corresponding to each bucket number (step S5). The load condition and the color of the bottle corresponding to each bucket number are read out from storage means 9g (step S6). The next step S7 starts a classification operation for delivering the bottles into delivery chutes 6a to 6d according to the bottle color, the bucket that is determined not to be in a glass bottle loaded condition is opened at delivery chute 6e of the others code.

In the classification operation, when a bucket reaches above the delivery chute 6a corresponding to a transparent colorless bottle, the load condition of the bucket is sensed. If the bucket is determined to be mounted with a transparent colorless bottle, the bucket bottom plate is opened. Meanwhile, when the bottle is not determined to be a transparent colorless bottle, the bucket is moved to above delivery chute 6b corresponding to a next color A to be determined whether the bottle color of



the bucket is the same as the color A. If the determination is positive, the bucket bottom plate opens to deliver the bottle having the color A into chute 6b. Subsequently, the color of the bottle in another bucket above delivery chute 6a is determined.

5 As repeating such operation, the bucket advances one by one to reach step S8. In step S8, if the color in the bucket is not identified with any of colorless and the colors A to C, the process proceeds to step S9 that releases the bottom plate of the bucket and then the process proceeds to step S10. When the bucket of no load condition reaches delivery chute 6e of
10 the others code, the no load condition is recognized and the process proceeds to step S9 that releases the bottom plate of the bucket and then the process proceeds to step S10. In step S10, the bottle color is determined whether it is identified with color C corresponding to delivery chute 6d. If the determination is positive, the process proceeds to step S11 to open the
15 bottom plate and then proceeds to step S12. Step S12 determines whether the bottle color of the bucket is color B to deliver the bottle delivery chute 6c corresponding to color B at step S13. Similarly, steps S14 and S15 operate in respect of color A. The next step S16 determines whether the bottle is identified with a colorless one corresponding to transparent
20 colorless bottle delivery chute 6a. If the determination is positive, the process proceeds to step S17 to open the bottom plate. The next step S18 determines the completion of the classification. If not completed, the process proceeds to step S19 that advances the buckets to repeat the operations in steps S8 to S19 in respect of a subsequent bucket. Thus, the
25 bottles are classified according to the bucket load conditions and the bottle colors.

In this embodiment, a count means 9d counts signals supplied from



bucket sensor 7. Based on the counted value, delivery position determination means 9e defines the positions of the buckets of which that the bottle has been discriminated in color. When the bucket reaches the corresponding delivery chute 6, an air cylinder 35 disposed in a side of delivery chute 6 operate to move upward roller 39 in the direction of an arrow in FIG. 5 so that the bottom plate hooking piece 38 is pivoted in a substantially lateral direction shown in FIG. 5 to release the bottom plate. The compression force of spring 40 opens bottom plate 32, delivering the bottle 10 at the corresponding delivery chute 6. The opened bottom plate 32 is closed again at a further downstream position by the bottom plate closing rail 37 so that hooking piece 38 holds the bottom plate of bucket 31. In respect of the bucket being in one of the load conditions that includes waste glass bottle loaded conditions not corresponding to colorless or the colors A to C, no load condition, and a cullet loaded condition, the bucket the bottom plate 32 is opened at delivery chute 6e coded as the others. Even if the bucket is carrying cullets, the cullets are delivered into delivery chute 6e of the others code. This eliminates the purity decrease, which has been a disadvantage in the known waste glass bottle color-classification apparatus, in classified colorless bottles.

Irrespective of outputs of bottle detecting sensor 4, pictures may be taken in respect of all the buckets to discriminate the color of the taken images. Even in that case, in respect of the bucket being in one of the load conditions that includes bottle loaded conditions not corresponding to colorless or colors A to C, no load condition, and a cullet loaded condition, the bucket bottom plate is opened at delivery chute 6e of the others code based on outputs from the bottle detecting sensor.

An operational effect of the embodiment will be discussed hereinafter.



As discussed above, in the bottle color-classification, in respect of a bucket being in no load condition, the bucket bottom plate is controlled to open not at the delivery chute corresponding to colorless bottles but at the delivery chute of the others code. Accordingly, colored cullets are not delivered into the delivery chute for receiving colorless bottles, greatly improving the purity of classified waste glass bottles, particularly of colorless glass bottles by the bottle color-classification.

A second embodiment

Referring accompanied drawings, a second embodiment of a waste glass bottle color-classification apparatus according to the present invention will be discussed hereinafter. FIG. 9 is a diagrammatic illustration of a waste glass bottle color discrimination apparatus including a control means according to the second embodiment of the invention. In FIG. 9, the bottle color discrimination apparatus includes a bottle feeding conveyor 1 delivered with waste glass bottles 11 from an in-size classification means such as a roller conveyor, a bottle orientating conveyor 2 for orientating the bottles delivered from the bottle feeding conveyor 1, a bucket conveyor 3 for receiving the bottles having been orientated by the bottle orientating conveyor 2 with the longitudinal direction of each bottle being perpendicular to the longitudinal direction of conveyor 3, a standing bottle detecting sensor 104 disposed at point A of bucket conveyor 3, a color discrimination means 5 positioned at a point as high as a middle height of bucket conveyor 3, a plurality of delivery chutes 6 disposed under bucket conveyor 3 for receiving the bottles according to their color, a bucket sensor 7 for recognizing the position of the bucket, a standing bottle delivering chute 8, and a circulation means 9 composed of belt conveyors or the like for transferring the bottles delivered in the standing bottle



delivering chute 8 to bottle feeding conveyor 1. Based on signals from control means 12, color-classification of the bottles and discharging of the standing bottles are handled by releasing devices 35a to 35d such as an air cylinder. The color discrimination means 5 is disposed at a height
5 suitable for sensing the bottle in each bucket.

Moreover, this embodiment includes a standing bottle detecting sensor 104 disposed at point A upstream from the color discrimination means 5. Bucket sensor 7 is disposed at point C. The standing bottle detecting sensor 104 detects whether each bucket has a bottle in a standing position
10 within the bucket.

In this embodiment, the bottle color discrimination apparatus is controlled by a control means 12. The control means 12 performs image processing of image signals of each waste glass bottle taken in the longitudinal direction of the bottle by color discrimination means 5 to
15 discriminate the bottle color. At the same time, control means 12 receives signals from bucket sensor 7 that generates a signal every when bucket 31 passes a predetermined point. Thus, the position of each bucket 31 is known by a count means for counting the signals from bucket sensor 7. The color of the bottle is recognized together with the corresponding bucket
20 number as well as the first embodiment. In addition, standing bottle detecting sensor 4 detects whether the bottle in each bucket 31 is in a standing position. Base on the detection, air cylinders 35a to 35d operates for removal of such standing bottles and for classification in color of the bottles.

25 Next, referring FIG. 10, a method for detecting standing bottles in the buckets will be discussed in details. A single waste glass bottle is supplied in each bucket 31 to lie down therein, but the supplied bottle may



become unintentionally in a standing position. The standing bottle loaded condition is sensed by standing bottle detecting sensor 4. For standing bottle detecting sensor 4 is applied, for example, a reflector type optical sensor. Alternatively, a transmission optical sensor, a photoelectric switch,
5 an ultrasonic sensor or a limit switch may be used. In addition, standing bottle detecting sensor 4 is not necessarily disposed at point A but may be positioned at point B in FIG. 9.

A standing bottle, as shown in FIG. 10, is standing in bucket 31 with the spout portion being extending above the side plates of bucket 31.
10 Therefore, standing bottle detecting sensor 4 is adjusted so that a light optical axis of the sensor 4 passes slightly above the side plates of bucket 31. Thus, when the standing bottle 11a mounted on the bucket crosses the optical axis, the optical intensity is changed, allowing to detect a standing bottle loaded condition of the bucket.

15 The spout portion of the bottle 11a may extend over a bucket 31a or 31c adjacent to bucket 31b having standing bottle 11a. In such a case, the optical axis of the standing bottle detecting sensor 4 is positioned at a height shown by a chain line L₁. When the bucket is moved in the direction shown by an arrow, the standing bottle detecting sensor 4 detects
20 the presence of a standing bottle at point D₁ or D₂. Thus, based on signals from the standing bottle detecting sensor 4, it is determined that bucket 31a or 31c has a standing bottle. Even if the optical axis of the standing bottle detecting sensor 4 is lowered at the height of a dotted line L₂, the presence of a standing bottle would be detected at point D₃ or D₄.
25 Thus, it is determined that there is a standing bottle in bucket 31c or 31b.

Accordingly, when the standing bottle detecting sensor 4 is positioned

at the height of L_1 , it is wrongly determined that bucket 31a or 31c has a standing bottle 11a, so that the bottom plate of bucket 31a or 31c is opened but a standing bottle 11a in bucket 31b is not removed to be transferred downstream. To eliminate the drawback, the bottom plates of
5 three buckets that are a bucket determined to be loaded with a standing bottle and a couple of buckets backward or forward adjacent to the determined bucket. This can positively remove a standing bottle 11a.

Next, a method for defining ongoing positions of the transferred buckets will be discussed in details.

10 In the embodiment, when the bucket sensor disposed at point C outputs a signal by perceiving a bucket, a color discrimination means 5 simultaneously senses a waste glass bottle in a bucket 31. At the same time, counting of the number of passing buckets starts for defining the positions of the buckets. That is, bucket sensor 7 is required only to detect
15 the timing when each bucket 31 pass a predetermined point. The distance from the standing bottle detecting sensor to delivery chute 8 is predetermined as a multiple of the interval length of the bucket row. Similarly, the distance from the color discrimination means to delivery chute 6 is predetermined. Thus, after the standing bottle detecting sensor
20 4 outputs a signal by perceiving a standing bottle 11a, the timing when the bucket having a standing bottle 11a passes just above delivery chute 8 is known by bucket sensor 7 that can count the number of buckets passing point C. Based on this information, the bottom plate of the bucket opens to deliver the standing bottle 11a into delivery 8 to remove it.

25 Furthermore, referring a control flow in FIG. 11, an operation for removing standing bottles 11a will be discussed. The waste glass bottle in-color discrimination apparatus discriminates waste glass bottles in



color to classify the waste bottles in color. In this operation, for example, when a waste glass bottle in a bucket is determined to be of color A, the bottle is recovered in a delivery chute for receiving waste glass bottles of color A by opening the bottom plate of the bucket to classify the bottles
5 when the bucket reach above the delivery chute. In step S20, when the standing bottle detecting sensor 4 detects the presence of a standing bottle, a standing bottle removal program shown by a control flow in FIG. 7 starts to remove a standing bottle. Step S21 stores in memory the number of the bucket having a standing bottle.

10 Step S22 counts pulses generated by bucket sensor 7 according to the passing of the buckets to know when the bucket having the standing bottle reaches delivery chute 8. Step S23 releases the bottom plate of a bucket forward adjacent to the bucket that has been determined to have a standing bottle at delivery chute 8. In the next step S24, as shown in FIG. 9,
15 the standing bottle is transferred from delivery chute 8 to be delivered in bottle feeding conveyor 1 by way of circulation means 9, as shown by arrows A3, A4, and A5.

In the next step S24, when the bucket that has been determined to have a standing bottle reaches delivery chute 8, the bottom plate of the bucket
20 opens to deliver a standing bottle, if present, into a delivery chute 8. Similarly, the bottle is supplied again into the bottle feeding conveyor 1 by way of circulation means 9.

In the next step S25, when a bucket backward adjacent to the bucket that has been determined to have a standing bottle reaches delivery chute
25 8, the bottom plate of the bucket opens to deliver a standing bottle, if present, into a delivery chute 8. Similarly, the bottle is supplied again into bottle feeding conveyor 1 by way of circulation means 9.



These steps for handling standing bottles can positively remove standing bottles to complete the removal process. Then, when the main program determines that the standing bottle detecting sensor 4 has detected the presence of a standing bottle base, the standing bottle
5 removal program starts again.

Meanwhile, a bucket 31 having a waste glass bottle 11 in a normally loaded condition passes without responding to both the standing bottle detecting sensor 4 and the bottom plate releasing device. The downstream color discrimination means 5 discriminates bottle 11 in color. Then, the
10 bucket 31 advances further downstream to reach the classification means. Based on the color determination of the bottle by color discrimination means 5, the bottom plate of the bucket opens at delivery chute 6 to separately recover the bottles 11 according to their colors. Like the standing bottle removal step, by counting pulses generated by bucket sensor
15 7, the position of a bucket 31 having a bottle 11 that has been discriminated in color is stored in memory. Thus, when the bucket reaches delivery chute 6, the bottle is correctly recovered by the releasing device for the bucket bottom plate.

Thus, by removing standing bottles upstream from color discrimination
20 means 5, color discrimination means 5 would not sense a label-covered bottle side body, thereby preventing the purity decrease in color of recovered waste glass bottles to eliminate the aforementioned drawback in the known classification method. In addition, if the standing bottle detecting sensor is disposed at least upstream from the classification means for separately
25 recovering bottles according to their colors and the standing bottle delivering chute is positioned downstream from the standing bottle detecting sensor, it is possible to operate a similar classification only by



modifying the control method of the control means 12.

FIG. 12 is a schematic illustration showing a waste glass bottle color discrimination apparatus according to a further embodiment modified from the second embodiment of the present invention. The apparatus includes a releasing device disposed downstream from color discrimination means 5 for releasing the bottom plates of the buckets.

The standing bottle detecting sensor 4 senses the presence or absence of a standing bottle, and then color discrimination means 5 discriminates the bottles in color. Delivery chute 8 is located adjacent to delivery chute 6. Above delivery chute 8 is arranged releasing device 35a. The other constructions are the same as the second embodiment shown in FIG. 9. However, the standing bottles having been delivered into delivery chute 8 for circulation may be accumulated to define a predetermined amount before delivered in bottle feeding conveyor 1.

Furthermore, sensing of standing bottles and color discriminating of bottles may be simultaneously performed at point A. The obtained information are forwarded to a storage means of control means 12 that controls removal of the standing bottles and classification of the bottles in color.

As mentioned above, in the bottle color discrimination apparatus according to the second invention, the orientating means can orientate waste glass bottles, which are delivered as randomly oriented bottles, in the transfer direction to form a line. Then, the bottles are moved into the bucket conveyor. When a bottle lies in its normal position, the color discrimination means can sense the bottle to discriminate it in color. If the bottle becomes in a standing condition at the moment of the transfer to the bucket conveyor, the standing bottle detecting sensor senses the

standing bottle loaded condition and at the same time the standing bottle detecting sensor starts to count signals from the bucket sensor to know the number of passing buckets. When the counted number becomes equivalent to the distance from point A related to the standing bottle detecting sensor to the position of the standing bottle delivering means, the bucket bottom plate opens to remove the standing bottle into the delivery chute.

In addition, the standing bottle is rarely standing in a vertical position and is usually in a slanting position so as to lean against a side wall of the bucket. Thus, in respect of a long waste glass bottle, the standing bottle detecting sensor may recognize that the standing bottle is mounted in a bucket forward or backward adjacent to the standing bottle loaded bucket. Accordingly, the standing bottle is not positively removed only by opening the bucket that has been recognized by the standing bottle detecting sensor. Thus, when the standing bottle detecting sensor has detected the presence of a standing bottle, the bottom plates of three buckets that are a bucket determined to be loaded with a standing bottle and a couple of buckets forward or backward adjacent to the determined bucket to positively remove the standing bottle. The standing bottle delivered into the delivery chute is fed again in an upstream of the orientating means by way of the circulation means to minimize the decrease in the handling amount of waste glass bottles due to the standing bottle removing device.

In the second embodiment, an optical sensor is applied for the bucket sensor, but alternatively a proximity detector may be applied for a metal bucket. In addition, when an optical sensor is utilized, a reflecting tape may be put on a side surface of the bucket, which provides an intensified reflected ray when the tape crosses the front face of the optical sensor, allowing the detection of the passing of the bucket. Alternatively,



an encoder may be applied for detecting the passing timing of the bucket without limited by the description of the embodiment.

Furthermore, each bucket may be provided with an identification mark that can be sensed by the bucket sensor. Together with the mark, each
5 bucket load condition including a standing bottle loaded condition and the color of the bottle are stored in memory for classification of the bottle.

Moreover, the in-size classification means (the roller conveyor) and the bottle orientating conveyor is not limited by the embodiment, but
10 various types of known similar devices can be used alternatively. But, considering the rates of the classification and the orientation, those of the above-mentioned embodiment are preferable.

In addition, the second embodiment can remove the standing bottles s, eliminating breakage of equipment surrounding the bucket that may abut
15 against the standing bottle. This eliminates an operation stop due to the breakage to improve the operation rate of the apparatus,



What is claimed is:

1. A waste glass bottle color-classification method comprising the steps of:

5 feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

sensing the load condition of the bucket,

optically sensing the waste glass bottle in the bucket to discriminate the bottle color,

10 discharging the waste glass bottle having been determined in color into a delivery chute corresponding to the determined color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining
15 bottles that have not been discriminated in color.

2. A waste glass bottle color-classification method comprising the steps of:

feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

20 optically sensing the inside of the bucket by a bottle detecting sensor to determine the load condition of the bucket,

sensing only the bucket that has been determined to be in a bottle loaded condition to discriminate the bottle color,

25 discharging the discriminated bottle into a delivery chute corresponding to the bottle color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining





bottles that have not been discriminated in color.

3. A waste glass bottle color-classification apparatus comprising:

a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles supplied in the buckets,

5 a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color,

a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can
10 not be discriminated in color,

a bucket sensor for sensing the pass of the bucket on the conveyor, and

a load condition determination means for sensing the load condition of each bucket on the conveyor,

wherein the load condition determination means can output a signal
15 indicating the empty condition of a bucket so as to open a bottom plate of the bucket at the chute for receiving the remaining bottles.

4. A waste glass bottle color-classification apparatus comprising:

(a) a bottle orientating means for orientating each waste glass bottle in its longitudinal direction,

20 (b) a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles each supplied in one of the buckets from the bottle orientating means in a perpendicular direction to the longitudinal direction of the bottle,

(c) a bottle color discrimination means for sensing the color of each
25 waste glass bottle supplied in the bucket on the conveyor,

(d) a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to





the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, the chutes being positioned downstream from the bottle color discrimination means and under the bucket conveyor,

5 (e) a bottle detecting sensor for determining the presence or absence of a waste glass bottle in the bucket,

(f) a bucket sensor for generating a signal to measure a timing when each bucket on the conveyor passes a relative predetermined point,

10 (g) a control means for classifying in color each bottle transferred by the bucket conveyor based on outputs each from the bottle detecting sensor, the bottle color discrimination means, and the bucket sensor, the control means generating a control signal to open both a bottom plate of the bucket which has been determined to be in no load condition by the bottle detecting sensor and a bottom plate of the bucket which can not
15 been discriminated in color at the delivery chute for receiving the remaining bottles.

5. An apparatus as claimed in claim 3 or 4, the bottle color discrimination means disposed in the upper stream of the bucket conveyor can optically sense the inside of the bucket to detect the color of each bottle in synchronization with the pass of the bucket having a bottle with using a
20 trigger timing signal that is obtained from a product of a detected signal of the bottle detecting sensor and a detected signal of the bucket sensor.

6. An apparatus as claimed in claim 4, said control means comprises:

25 a load condition determination means for determining the load condition of the bucket based on a signal sensed by the bottle detecting sensor,

a bucket detection signal generating means for generating a bucket





detection signal based on a signal sensed by the bucket sensor during the pass of the bucket,

an optically sensing timing signal generating means for generating a timing signal based on a product of outputs from both the bucket detection
5 signal generating means and the load condition determination means,

a color discrimination signal generating means for discriminating the color of the bottle based on an output from the bottle color discrimination means, and

a classification control signal generating means for receiving signals
10 supplied from the bucket detection signal generating means to generate a control signal for opening a bottom plate of a bucket carrying a bottle having a predetermined color and of a bucket carrying no bottle respectively at the corresponding delivery chute.

7. A waste glass bottle color-classification apparatus comprising:
15 a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and

a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to
20 the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

wherein the presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery
25 chute, and the color of a bottle that has not been determined to be a standing one is discriminated in color so that the bottle is classified to be discharged into a delivery chute corresponding to the color of the bottle.





8. An apparatus as claimed in claim 7, wherein the standing bottle having been discharged into the delivery chute is circulated by feeding the bottle on the bottle orientating means again.

9. A waste glass bottle color-classification apparatus comprising:

5 (a) a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle,

(b) a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

(c) a bottle color discrimination means for discriminating the color of a bottle mounted on each bucket on the conveyor,

15 (d) a plurality of delivery chutes disposed downstream from the bottle color discrimination means and under the bucket conveyor, each chute corresponding to each one of predetermined colors,

(e) a standing bottle removal means for precluding a bottle in one of the buckets,

20 (f) a bucket sensor for sensing the timing of the pass of each bucket on the conveyor, and

(g) a separation means for discharging each bottle transferred by the bucket conveyor into the delivery chute corresponding to the bottle color.

25 10. An apparatus as claimed in claim 9, wherein the standing bottle removal means comprises:

(a) a standing bottle detecting sensor for sensing each transferred bottle to determine whether the bottle is standing in the bucket in an





upstream side of the bottle color discrimination means,

(b) a standing bottle discharging chute positioned on the way from the standing bottle detecting sensor to the color discrimination means and under the bucket conveyor,

5 (c) a standing bottle removal means for discharging the standing bottle in the standing bottle delivery chute .

11. An apparatus as claimed in claim 9, wherein

the standing bottle removal means can determine each bucket whether the bucket has a standing bottle based on both an output signal of the standing bottle detecting sensor and an output signal of the bucket sensor,
10 and also can discharge the bottle into the standing bottle delivery chute by opening the bottom plates of the determined bucket and also by opening the bottom plates of a couple of buckets each positioned backward or forward adjacent to the determined bucket .

15 12. An apparatus as claimed in claim 10 or 11, wherein the standing bottle delivery chute has a container for receiving and storing the removed bottles or has a circulation device for returning the removed bottles upstream from the bottle orientating means.



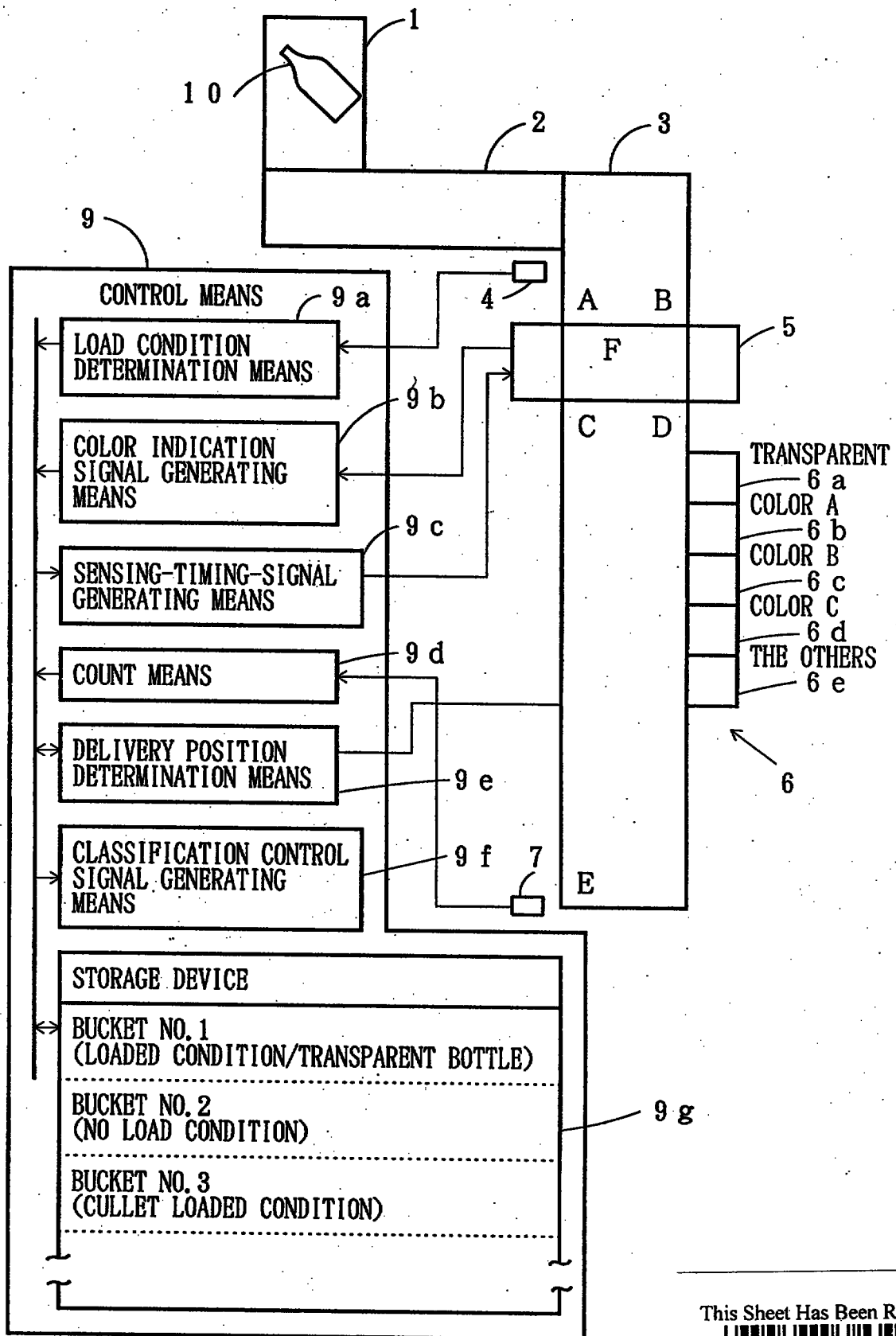
ABSTRACT OF THE DISCLOSURE

5 A waste glass bottle color-classification apparatus includes a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles supplied in the buckets, a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color, a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of
10 the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, a bucket sensor for sensing the pass of the bucket on the conveyor, and a load condition determination means for sensing the load condition of each bucket on the conveyor. Another waste glass bottle color-classification apparatus
15 includes a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means to transfer the bottles substantially in a perpendicular direction to the longitudinal
20 orientated direction of the bottles, each bucket having an openable bottom plate. The presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery chute.

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FIG. 1



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FIG. 2A

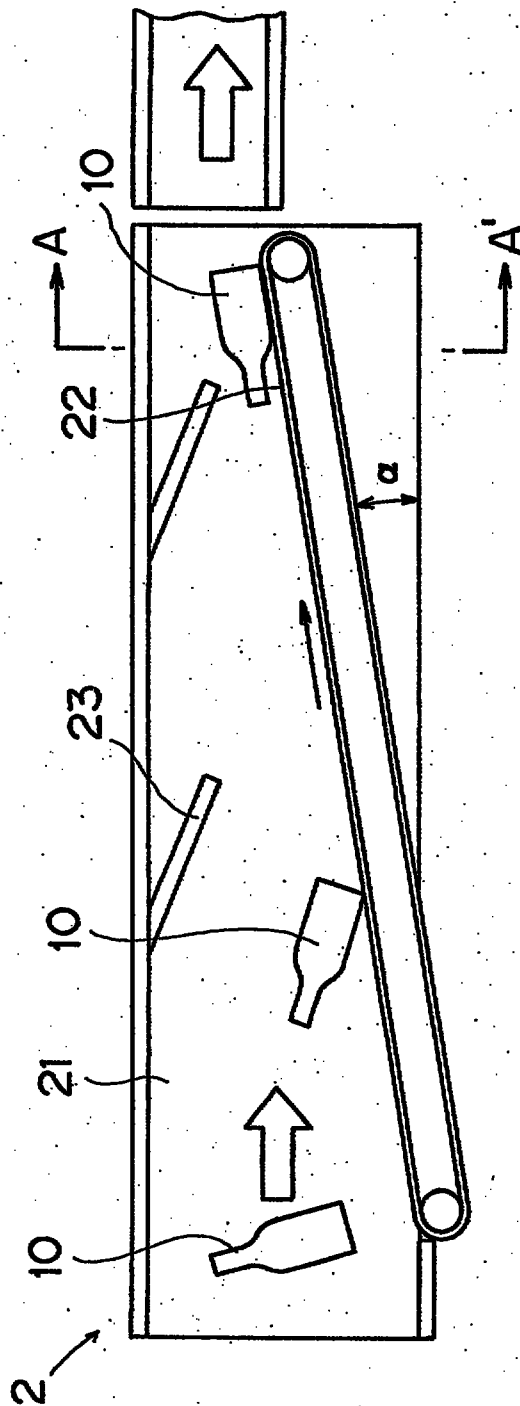


FIG. 2B

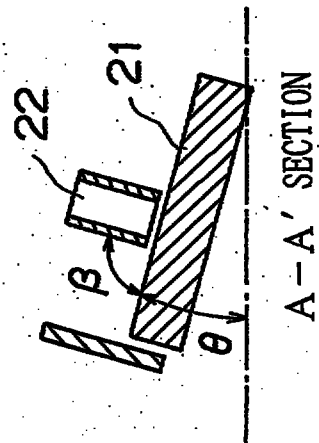


FIG. 3

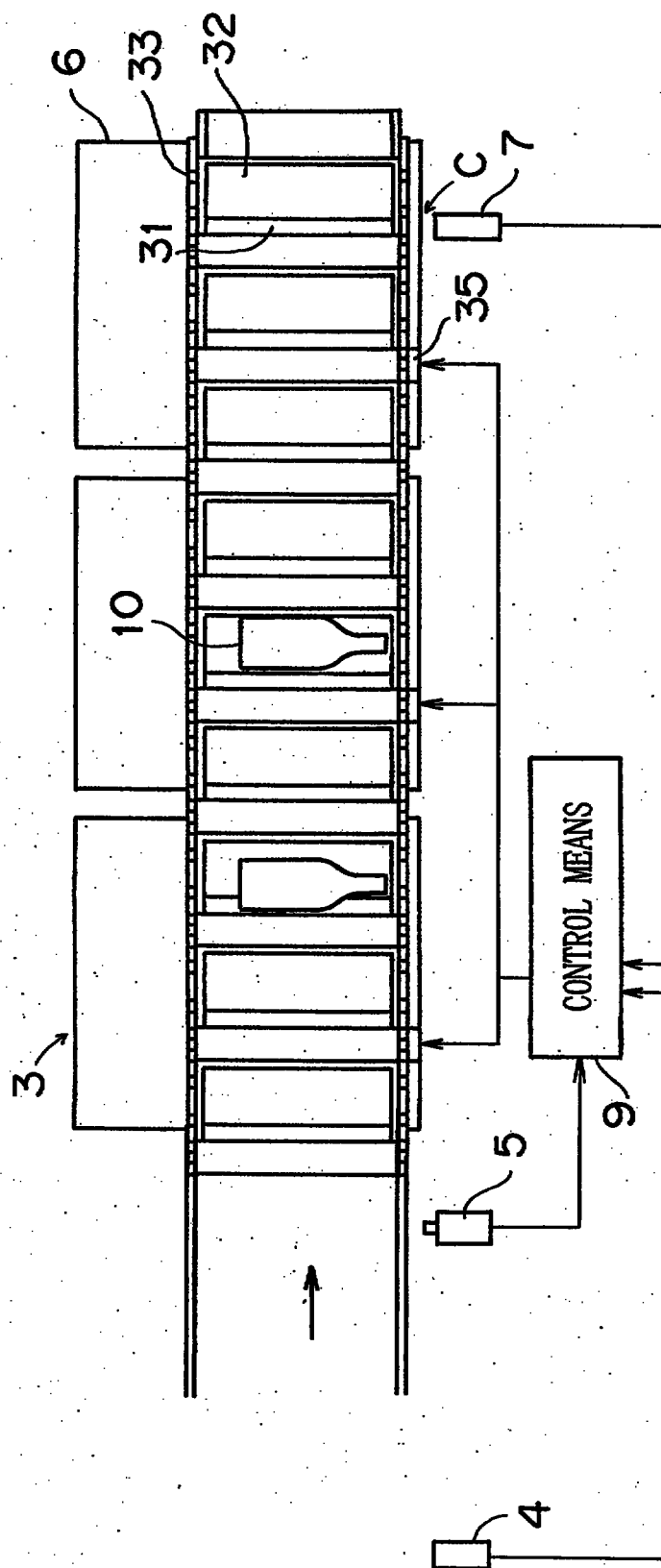
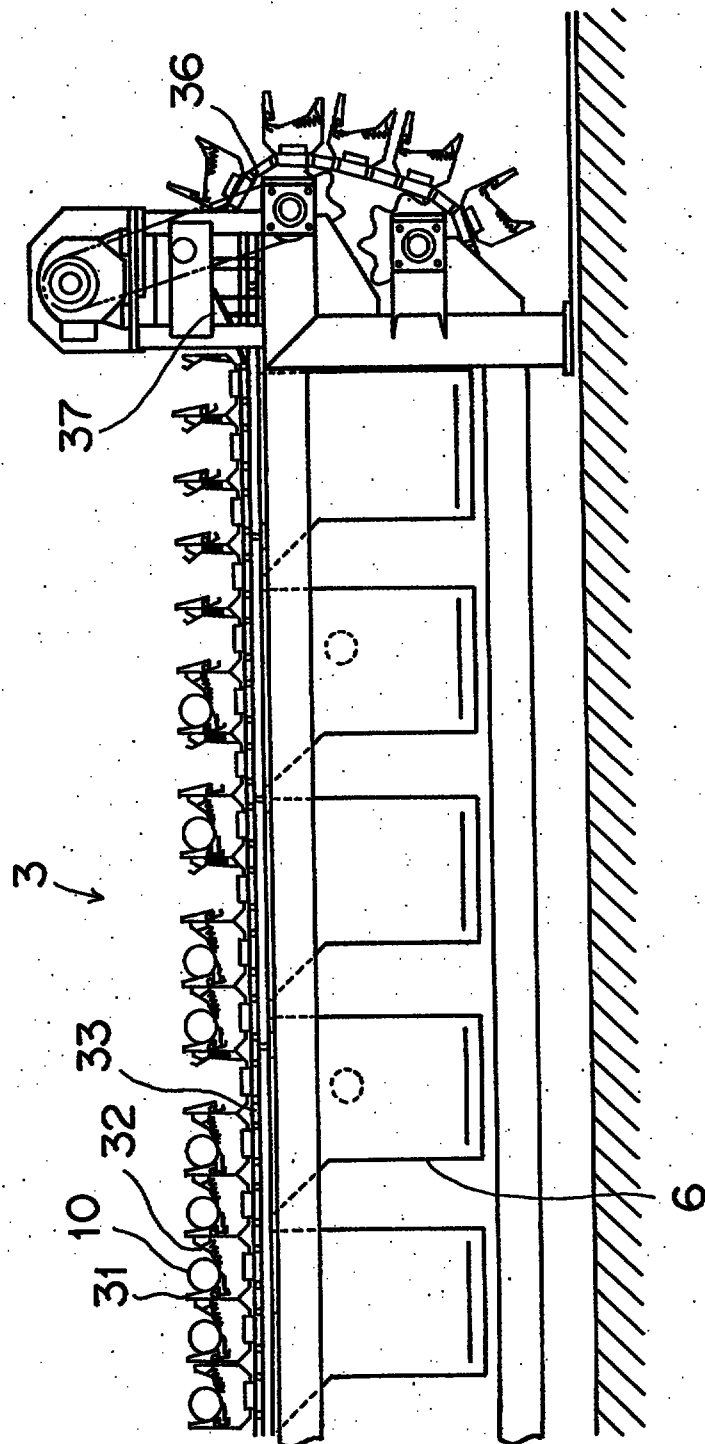


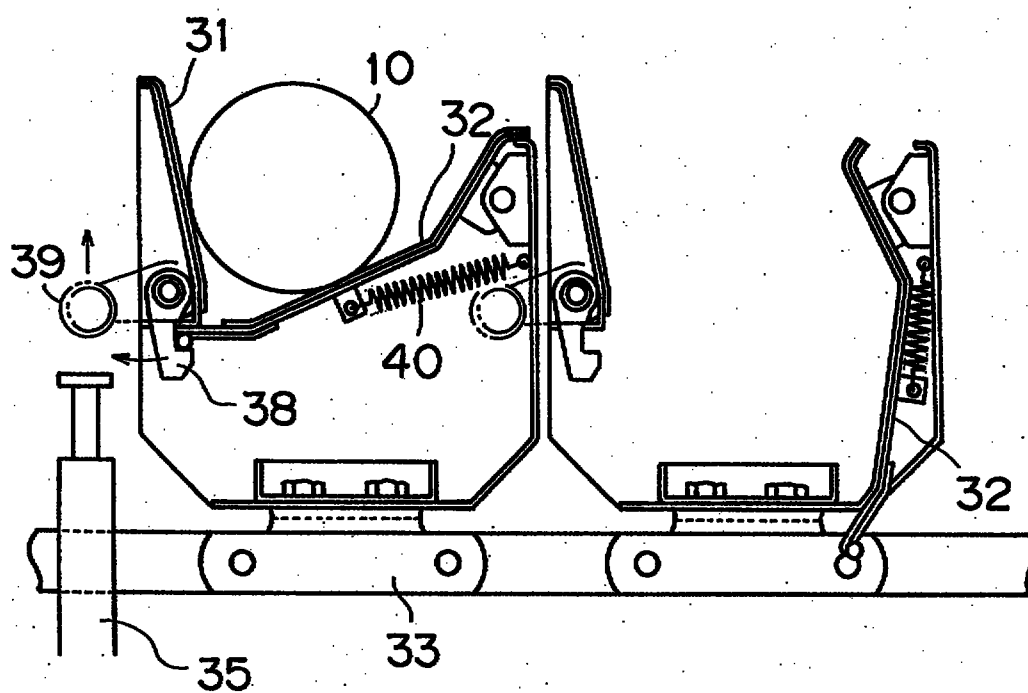
FIG. 4



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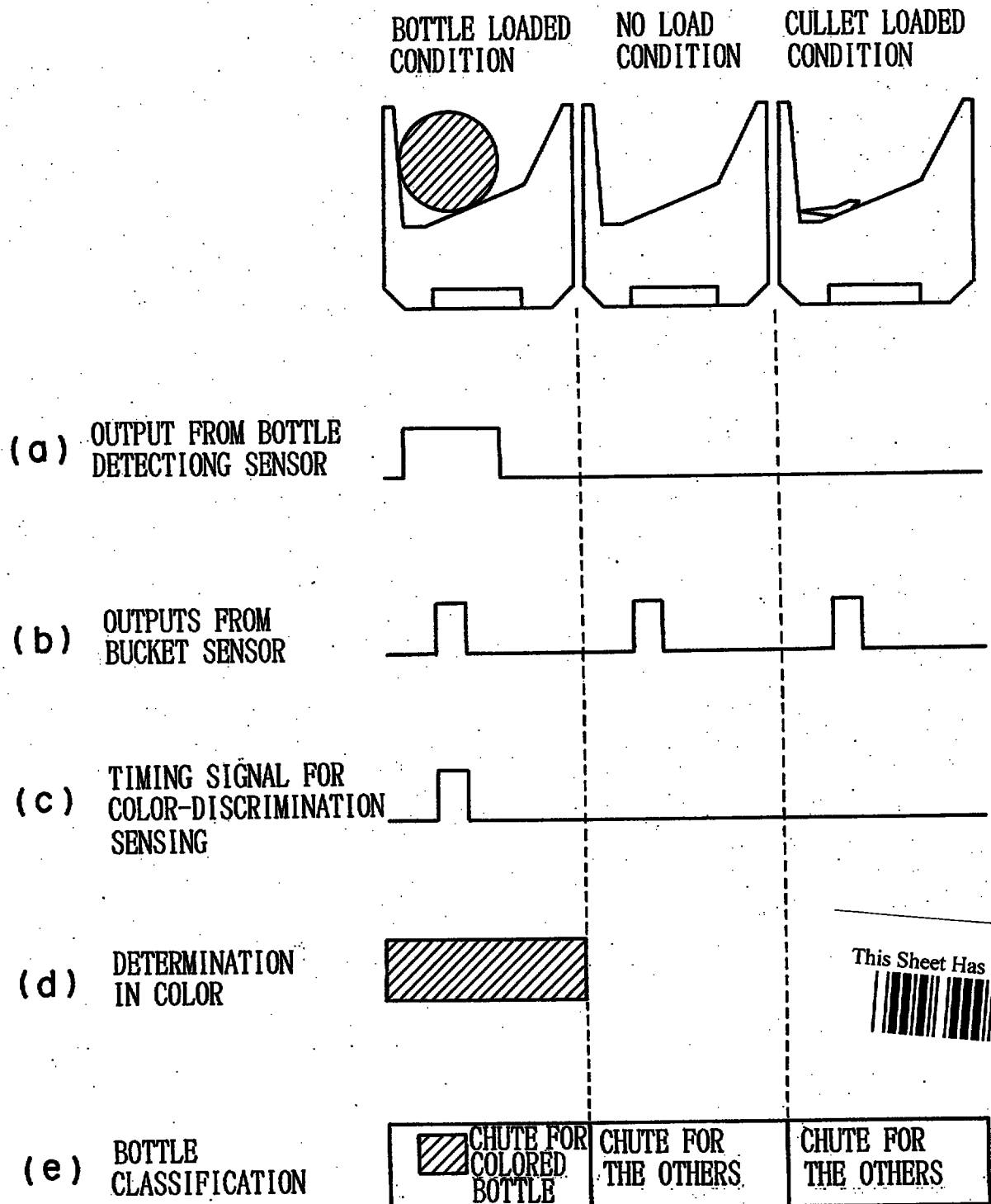
FIG. 5



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FIG. 6



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FIG. 7

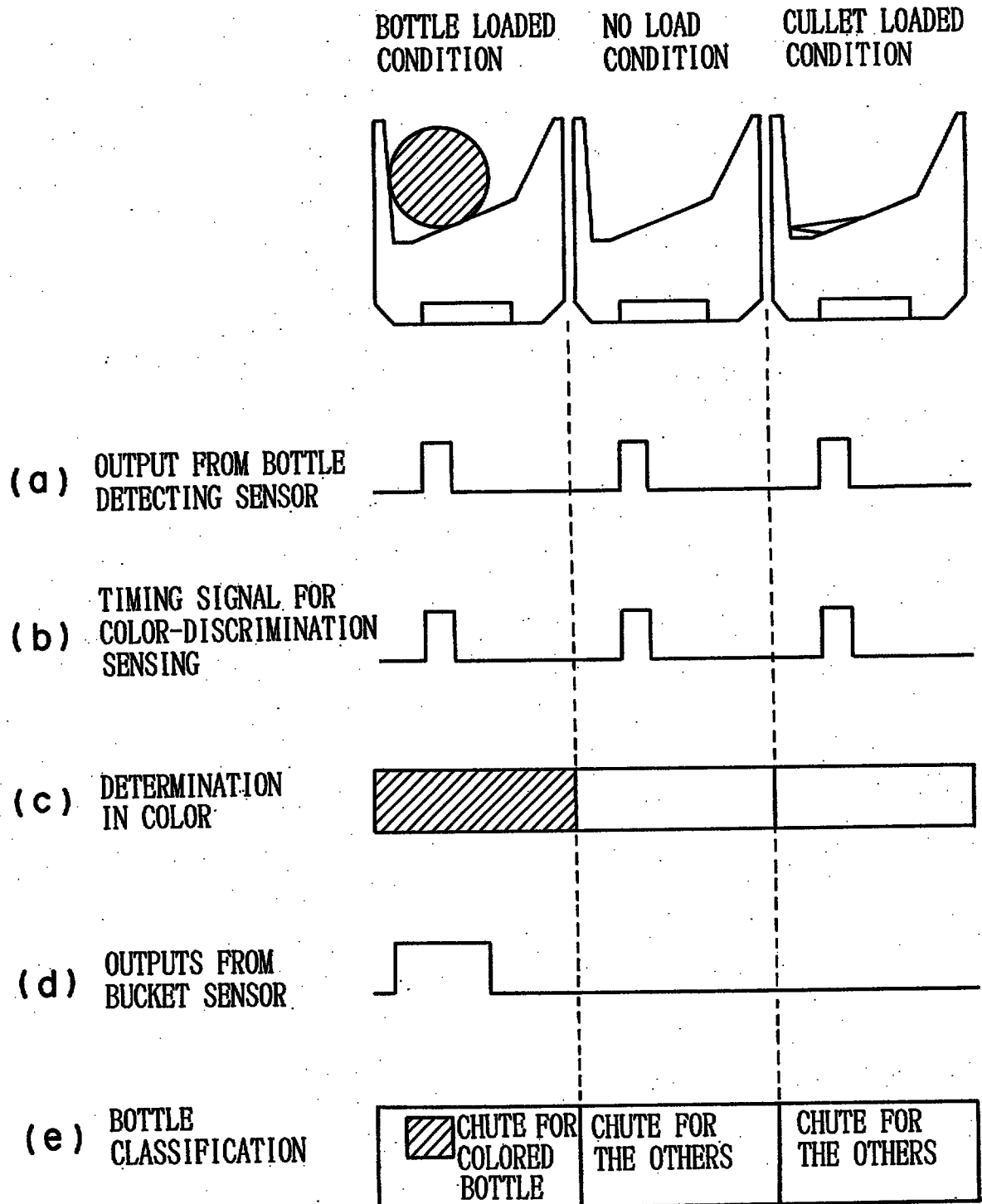
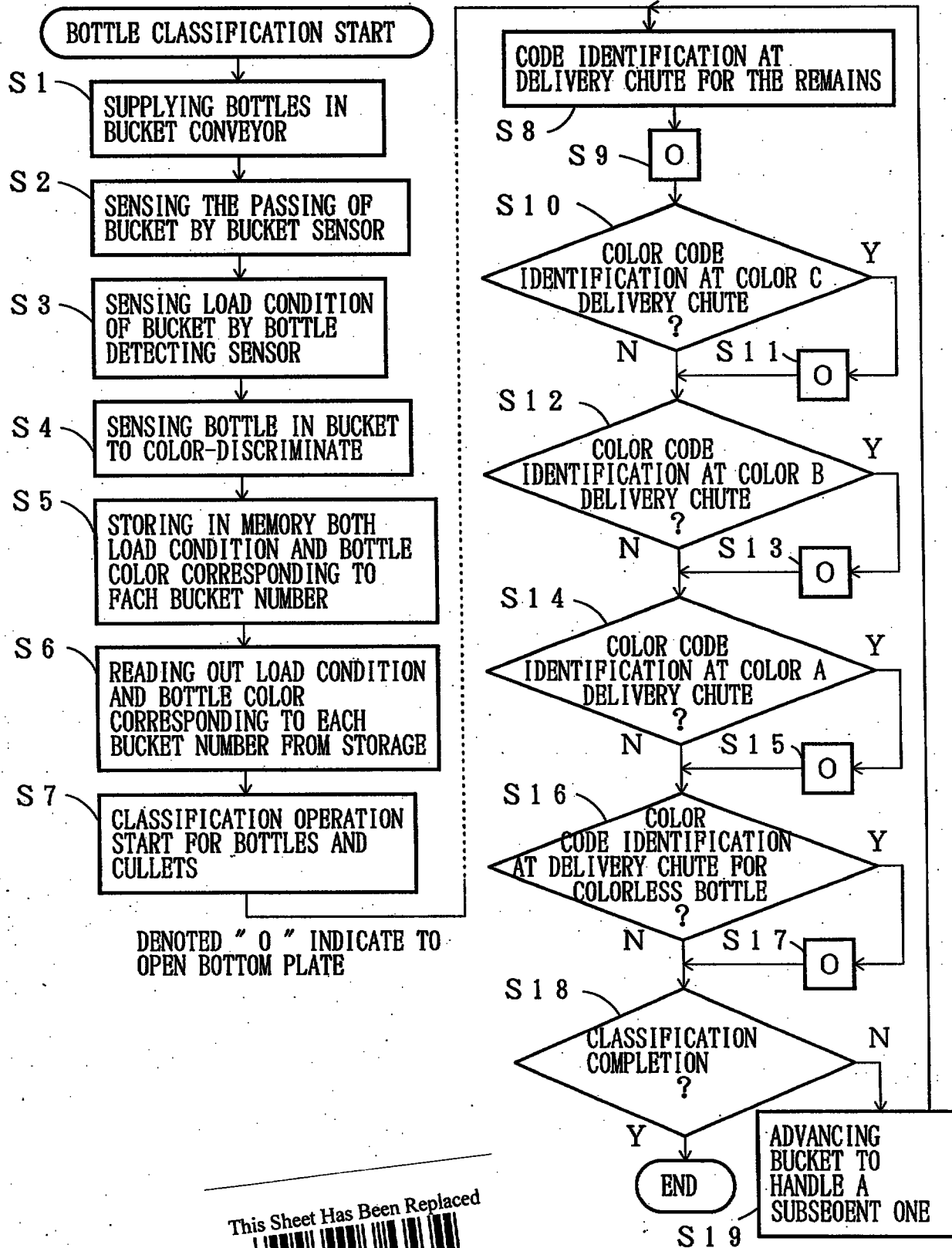


FIG. 8



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FIG. 9

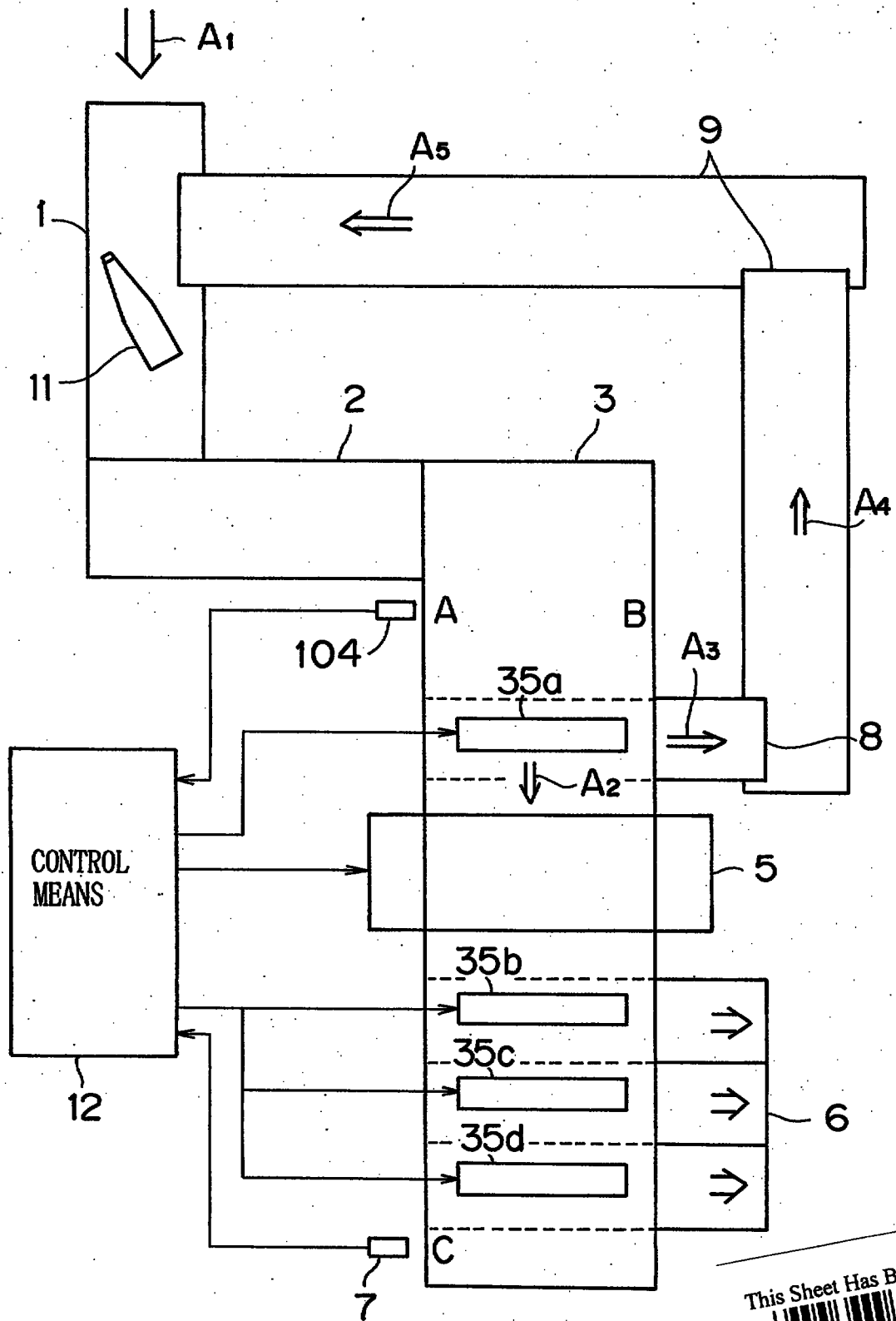
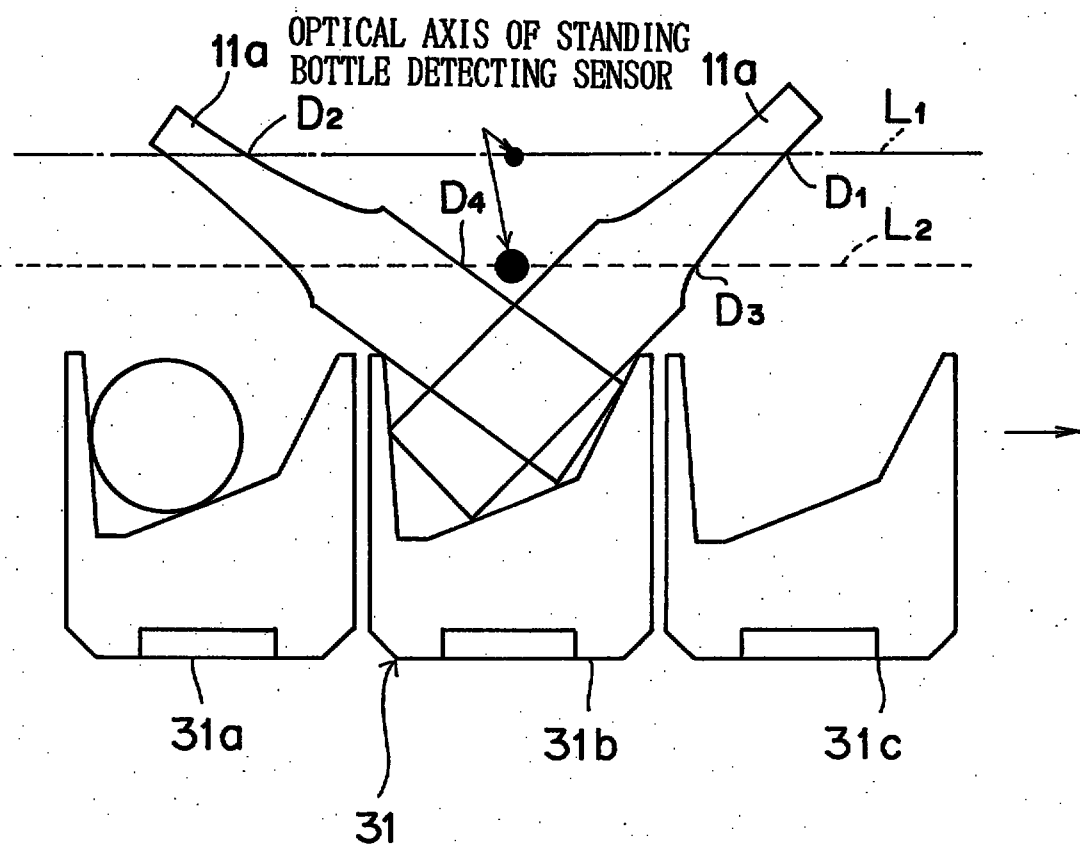


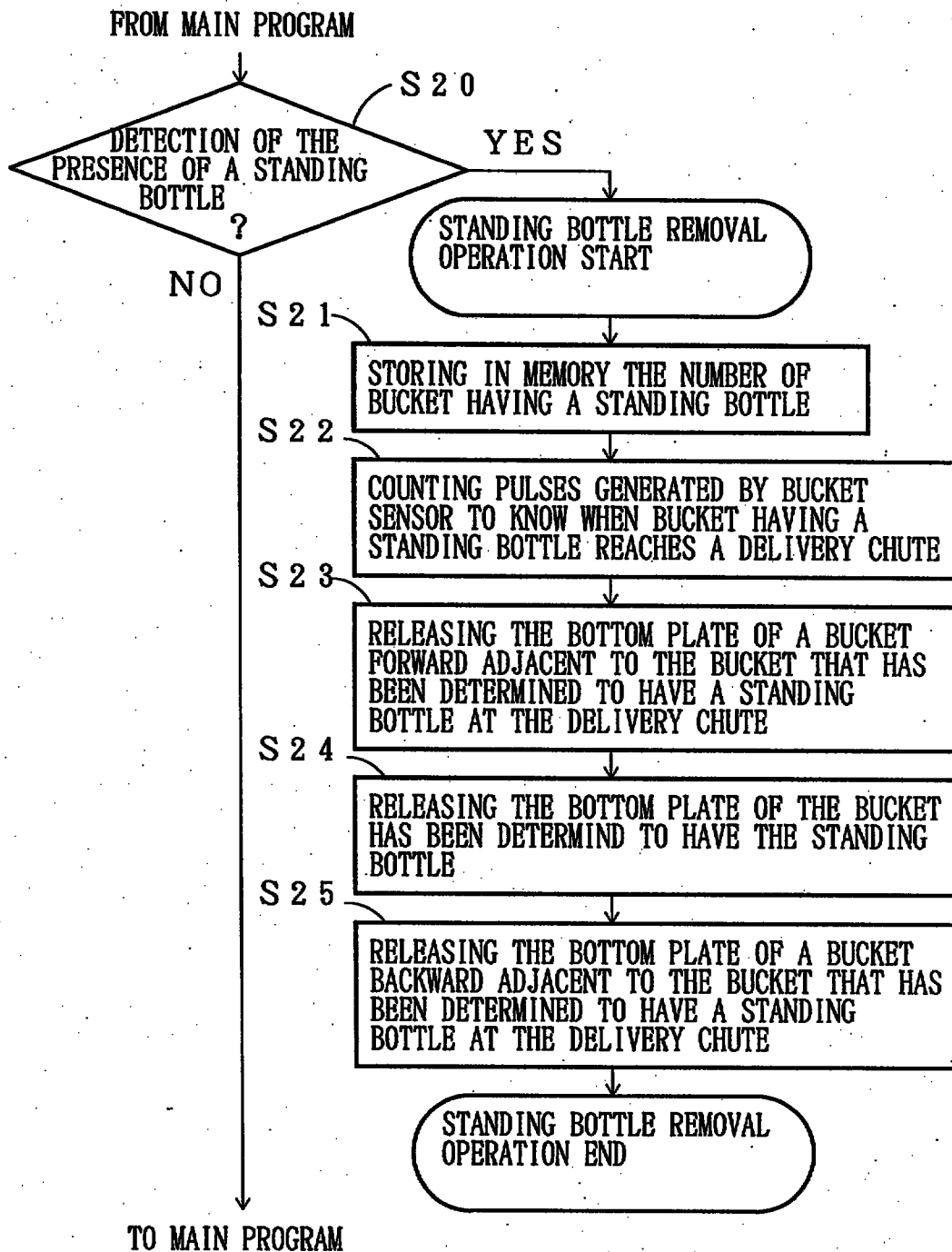
FIG. 10



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FIG. 11



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FIG. 12

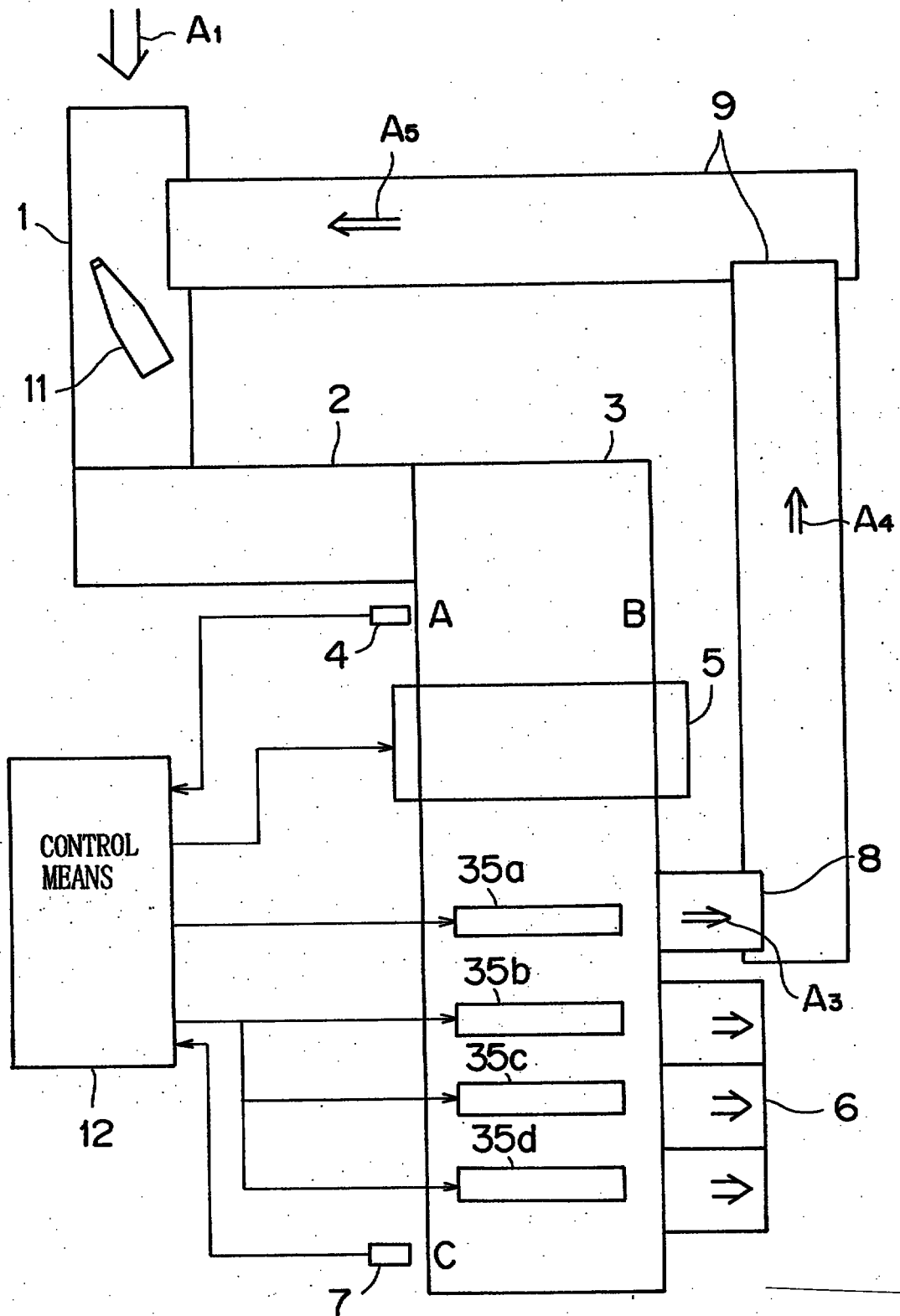


FIG. 13
PRIOR ART

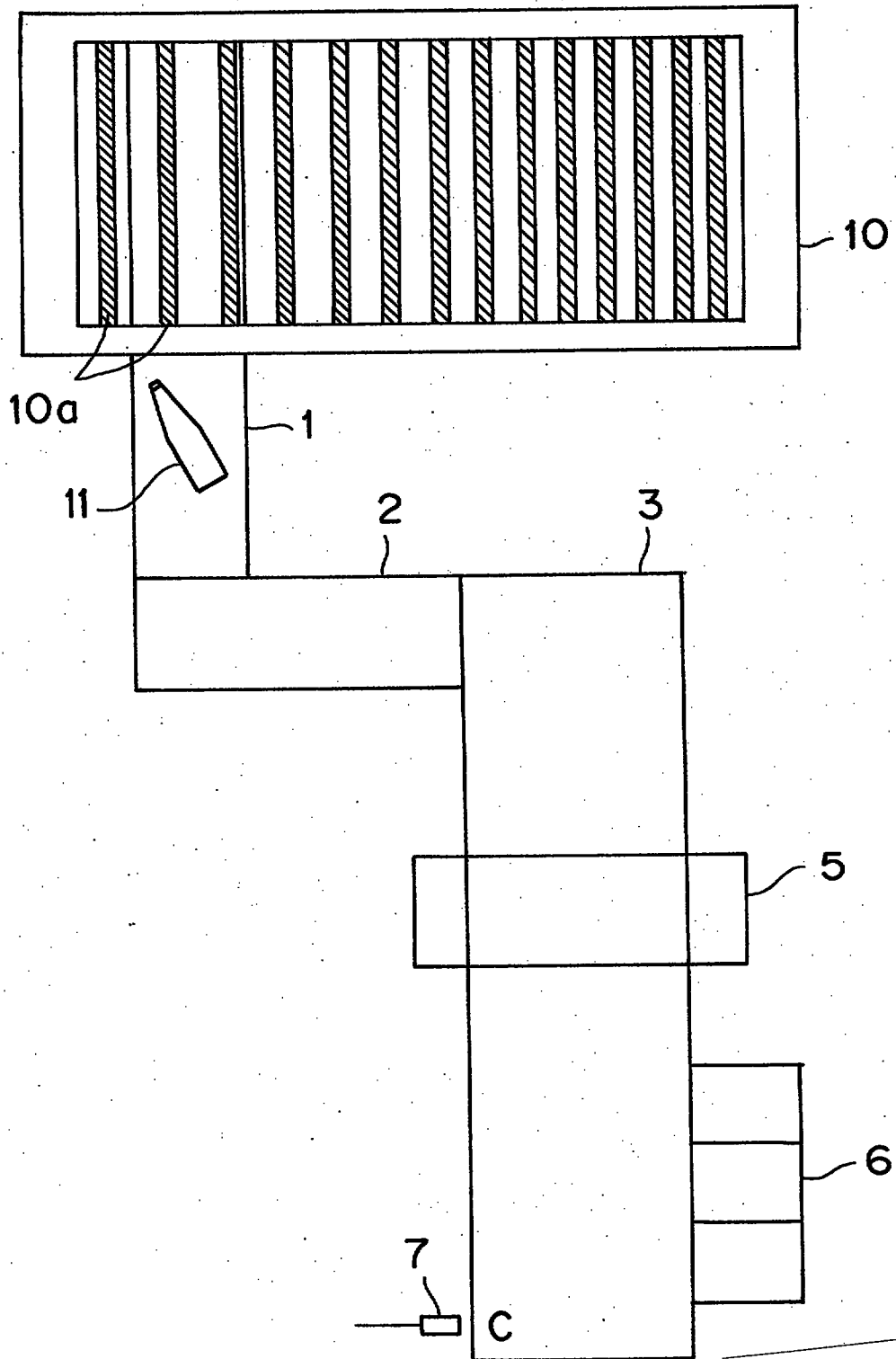
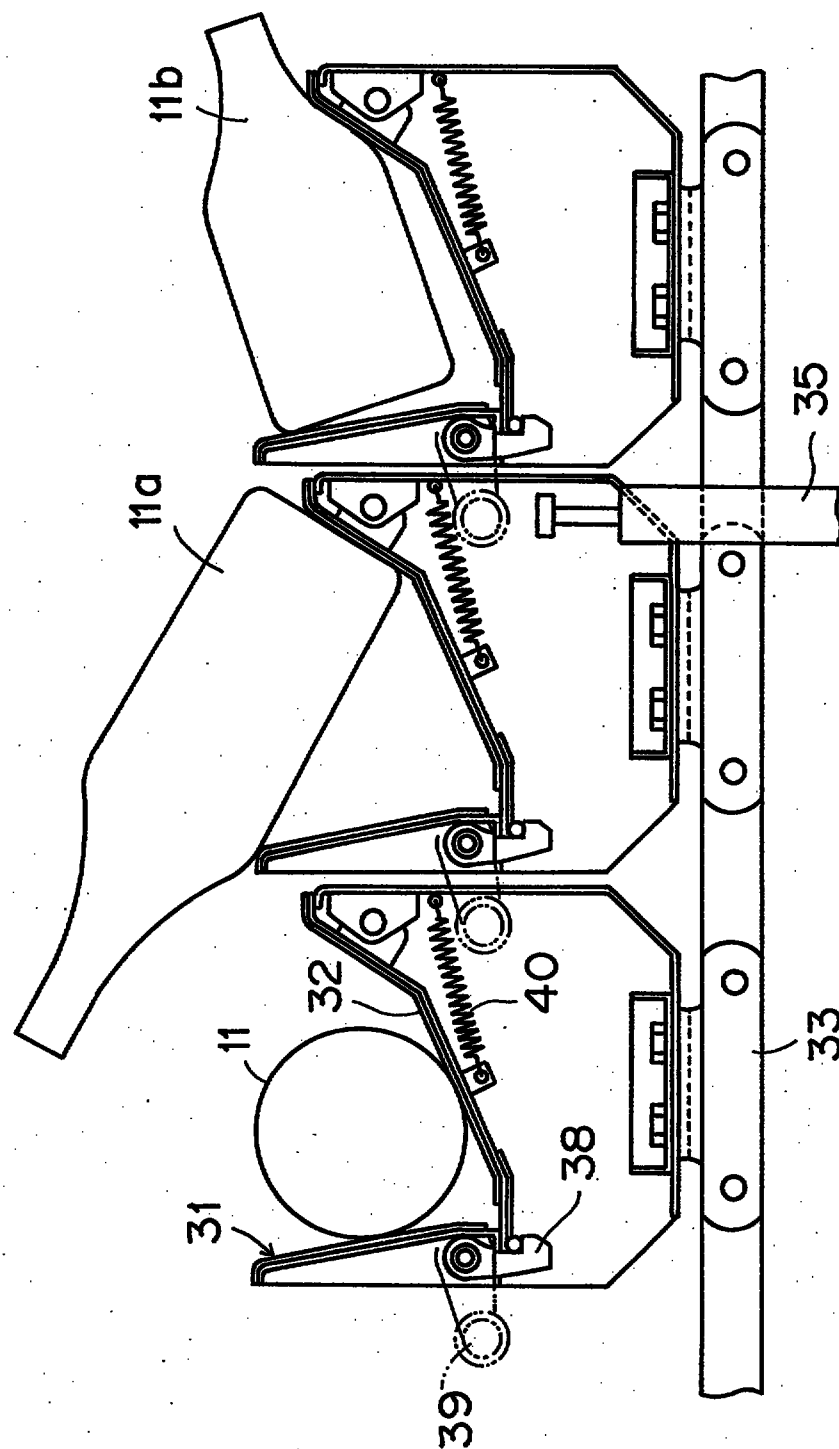


FIG. 14
PRIOR ART



REPLACEMENT SHEETS		SG
☒ Description	: paged 1. to paged 34	
☒ Claim(s)	: paged 35. to paged 40	
☒ Drawing(s)	: paged 1. to paged 14	
☒ Abstract	: paged 41. to paged	
DATE OF RECEIPT		21/1/98

WASTE GLASS BOTTLE COLOR-CLASSIFICATION METHOD AND APPARATUS OF THE SAME

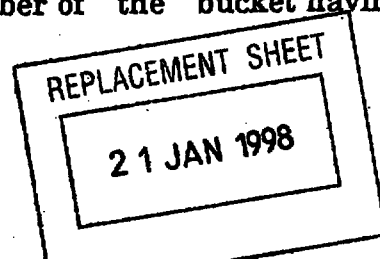
FIELD OF THE INVENTION

The invention relates to a waste glass bottle color-classification apparatus for classifying waste glass bottles in color, more particularly to a waste glass bottle color-classification apparatus and a classification method of the same for recycling the bottles as resources. The apparatus has a bucket conveyor for automatically classifying waste glass bottles in color and selectively has a device for precluding bottles standing in the buckets.

BACKGROUND OF THE INVENTION

FIG. 13 is a diagrammatic illustration showing a known waste glass bottle color-classification apparatus. In the figure, there is provided a roller conveyor 10 for classifying waste glass bottles in size. The conveyor includes a couple of chains between which a lot of rotatable rollers 10a are disposed to be connected to the chains. Each space between a couple of adjacent rollers 10a is widened gradually in the advancing direction of the conveyor, which can classify waste glass bottles 11 in size based on main body diameters of the bottles.

First, waste glass bottles 11 are supplied on roller conveyor 10 to be classified in size. The classified bottles 11 are orientated in its longitudinal direction to form a line by an orientating means 2, and then are moved on a bucket conveyor 3 positioned downstream from orientating means 2. Bucket conveyor 3 is provided with such buckets 31 as shown in FIG. 14. Each waste glass bottle 11 on buckets 31 is discriminated in color by a color discrimination apparatus 5 and the number of the bucket having

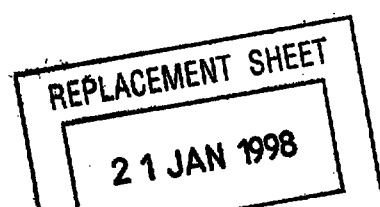


the bottle is recognized at the same time.

An image obtained by optically sensing each glass bottle 11 in the longitudinal direction of the bottle, that is, from the spout side or from the bottom side of the bottle is processed to discriminate the bottle color. Waste glass bottle 11 is further moved toward a delivery chute 6 by bucket conveyor 3. When each bucket 31 reaches delivery chute 6 corresponding to the bottle color determined by color discrimination means 5, which can be known by the bucket number, a bottom plate 32 of the bucket 31 is opened to classify bottles 11 in color.

In addition, for discriminating colorless glass bottles, bottle color discrimination means 5 determines based on whether the background color at the optically sensing point for the bottles is consistent with the sensed color of the bottle. Meanwhile, in an empty bucket with no bottle, bottle color discrimination means 5 determines that the sensed color is in consistent with the background color, which causing the bottom plate of the empty bucket to open at the delivery chute for receiving colorless waste glass bottles.

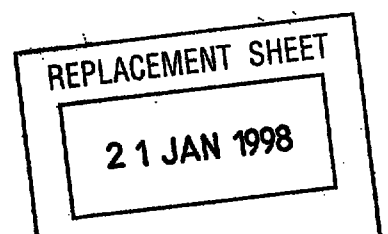
The known classification apparatus has another disadvantage described hereinafter. Waste glass bottles recycled as resources are disposed in a very fragile condition due to the mutual abutting of bottles which are in an uneven state during the gathering thereof. Accordingly, the classification means mostly receives waste glass bottles that include cullets (fragmented glass bottles). Smaller ones of the cullets can be precluded in an upstream side from the bottle orientating means by the aforementioned roller conveyor for bottle classification in size. However, since there are numerous types of cullets in size and furthermore the bottles themselves are different in size or in length, the classification means



can not preclude completely the cullets, causing the remained cullets to be supplied into the bottle orientating means. Moreover, some of the bottles may be broken after passing the bottle in-size classification means. Thus, the known waste glass bottle color-classification apparatus has the disadvantage that these cullets are transferred to the bucket conveyor together with complete bottles to be received in the delivery chute 6.

In the known waste glass bottle color-classification apparatus, there are three types of bucket load conditions when the buckets pass the bottle color discrimination means, which include a bottle transferring condition, no load condition, and a cullet transferring condition. With regard to the bucket in the bottle transferring condition, the bottle color discrimination means can correctly discriminate the color of each glass bottle based on sensed signals to classify the bottles. However, in the cullet load condition, there is a possibility that the load condition is be incorrectly determined. Particularly, when a flat cullet is disposed along an inner surface of a bucket, the bottle color discrimination means can not obtain an output sufficient for color determination, since the optically sensing for the object in each bucket is carried out horizontally from a lateral side of the bucket in a perpendicular direction to the bucket transfer direction so that the optically sensing area of the flat cullet is small. For this disadvantage, the bottle color discrimination means may determine a bucket having a cullet to be an empty bucket. Accordingly, the bottom plate of a bucket having a colored cullet is possibly opened at a delivery chute for colorless bottles so that colored cullets may be mixed into colorless recovered bottles to disadvantageously decrease the purity of the colorless bottles.

The known waste glass bottle color-classification apparatus has a further disadvantage described hereinafter. In the known classification



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apparatus, the orientating means 2 orientates the bottles 11 to form a line in the its longitudinal direction. Then, the bottles are moved into the bucket conveyor 3 traveling in a perpendicular direction to the advancing direction of the orientating means 2. Each bucket 31 mounted on bucket conveyor 3, as shown in FIG. 10, has an upwardly opened configuration.

Accordingly, when transferring a waste glass bottle 11 into a bucket 31 on the bucket conveyor 3 is good in timing, the bottle 11 can be positively received in the bucket 31 with the bottle being in a laid position. However, a bad timing causes bottle 11 to abut against an upper inner wall of the bucket, which makes the bottle stand in the bucket 31 occasionally. Such standing bottles, as illustrated by waste glass bottles 11a, 11b in FIG. 10, are mostly positioned with their spouts being directed upward and their bottoms downward. A color discrimination apparatus 5 disposed to be consistent with the height of the bucket conveyor 3 can optically sense the color of the laid bottle 11 in the bucket 31 in the bottle longitudinal direction, that is, toward the spout or bottom of the bottle. Meanwhile, the above-mentioned standing bottle in the bucket 31 is optically sensed at the bottle main body for color-discrimination. The bottle main body has a thin glass thickness, which is disadvantageous for recognition of color, possibly causing that a colored glass bottle is determined to be a colorless transparent bottle. In addition, on the bottle main body is affixed one of variously colored labels. Thus, the standing bottle may be wrongly determined in color discrimination due to the label on the main body. Moreover, the standing bottle transferred by the bucket may abut against the color discrimination means 5 disposed in alignment with the middle height of the bucket conveyor 3 or against a cover for a sprocket wheel 36

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of bucket conveyor 3 or etc. Accordingly, there is a possibility of a serious damage in the apparatus.

SUMMARY OF THE INVENTION

In view of the aforementioned disadvantages, an object of the invention is to provide a waste glass bottle color-classification method and an apparatus of the same, which can prevent the decrease of purity degree in color with regard to recovered waste glass bottles by sensing the bottle load condition of each bucket.

Another object of the invention is to provide a waste glass bottle color-classification apparatus that can classify waste glass bottles in a high degree of purity in color.

Considering the aforementioned disadvantages, in a first configuration of the invention, a waste glass bottle color-classification method comprising the steps of:

feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

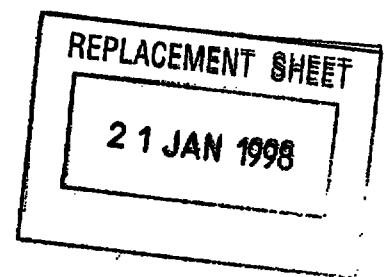
sensing the load condition of the bucket,

optically sensing the waste glass bottle in the bucket to discriminate the bottle color,

discharging the waste glass bottle having been determined in color into a delivery chute corresponding to the determined color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining bottles that have not been discriminated in color.

That is, since there may be colored cullets in a bucket that is determined to be in no load condition at the step for sensing the bucket



load condition, the bottom plate of the bucket that has been determined to be in no load condition is opened at the delivery chute for receiving the remaining bottles that have not been discriminated in color. This prevents colored cullets from getting mixed with colorless transparent bottles.

In a second configuration of the invention, a waste glass bottle color-classification method comprising the steps of:

feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

optically sensing the inside of the bucket by a bottle detecting sensor to determine the load condition of the bucket,

sensing only the bucket that has been determined to be in a bottle loaded condition to discriminate the bottle color,

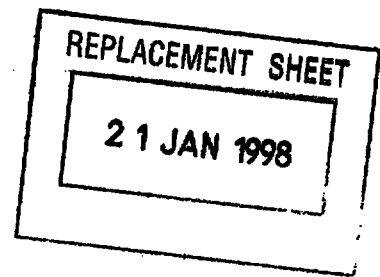
discharging the discriminated bottle into a delivery chute corresponding to the bottle color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining bottles that have not been discriminated in color.

That is, only the buckets that have been determined to be in a bottle loading condition are discriminated in color of the loaded bottles. Meanwhile, the bottom plate of a bucket that is determined to be in no load condition is opened at the delivery chute for receiving the remaining bottles, preventing colored cullets from getting mixed with colorless transparent bottles. This can eliminate one of the disadvantages described in the known bottle classification apparatus.

In a third configuration of the invention, a waste glass bottle color-classification apparatus comprising:

a bucket conveyor having a plurality of buckets each with an openable



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bottom plate and transferring waste glass bottles supplied in the buckets,

a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color,

a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color,

a bucket sensor for sensing the pass of the bucket on the conveyor, and

a load condition determination means for sensing the load condition of each bucket on the conveyor,

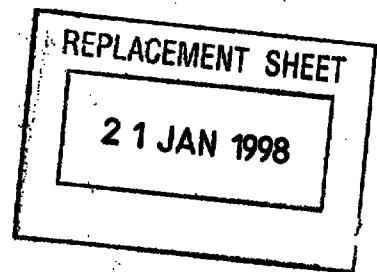
wherein the load condition determination means can output a signal indicating the empty condition of a bucket so as to open a bottom plate of the bucket at the chute for receiving the remaining bottles.

The load condition determination means may be a type of known various devices for sensing the inside of the bucket. The determination means can control an empty bucket to open its bottom plate at the chute for receiving the remaining bottles because the empty bucket may have a cullet yet. This prevents colored cullets from getting mixed with classified colorless transparent bottles.

In a fourth configuration of the invention, a waste glass bottle color-classification apparatus comprising:

(a) a bottle orientating means for orientating each waste glass bottle in its longitudinal direction,

(b) a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles each supplied in one of the buckets from the bottle orientating means in a perpendicular direction to the longitudinal direction of the bottle,



(c) a bottle color discrimination means for sensing the color of each waste glass bottle supplied in the bucket on the conveyor,

(d) a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, the chutes being positioned downstream from the bottle color discrimination means and under the bucket conveyor,

(e) a bottle detecting sensor for determining the presence or absence of a waste glass bottle in the bucket,

(f) a bucket sensor for generating a signal to measure a timing when each bucket on the conveyor passes a relative predetermined point,

(g) a control means for classifying in color each bottle transferred by the bucket conveyor based on outputs each from the bottle detecting sensor, the bottle color discrimination means, and the bucket sensor, the control means generating a control signal to open both a bottom plate of the bucket which has been determined to be in no load condition by the bottle detecting sensor and a bottom plate of the bucket which can not be discriminated in color at the delivery chute for receiving the remaining bottles.

Thus, based on information from each sensor, the control means can open the bottom plate of the bucket that may have colored cullets at the delivery chute for receiving the remaining bottles, which advantageously preventing colored cullets from getting mixed with classified colorless transparent bottles.

In a fifth configuration of the invention, the apparatus as claimed in the third configuration of the invention further includes that the bottle color discrimination means disposed in the upper stream of the bucket

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conveyor can optically sense the inside of the bucket to detect the color of each bottle in synchronization with the pass of the bucket having a bottle with using a trigger timing signal that is obtained from a product of a detected signal of the bottle detecting sensor and a detected signal of the bucket sensor.

In a sixth configuration of the invention, the apparatus as claimed in the fourth configuration of the invention further includes that the control means comprises:

a load-condition determination means for determining the load condition of the bucket based on a signal sensed by the bottle detecting sensor,

a bucket detection signal generating means for generating a bucket detection signal based on a signal sensed by the bucket sensor during the pass of the bucket,

an optically sensing timing signal generating means for generating a timing signal based on a product of outputs from both the bucket detection signal generating means and the load condition determination means,

a color discrimination signal generating means for discriminating the color of the bottle based on an output from the bottle color discrimination means, and

a classification control signal generating means for receiving signals supplied from the bucket detection signal generating means to generate a control signal for opening a bottom plate of a bucket carrying a bottle having a predetermined color and of a bucket carrying no bottle respectively at the corresponding delivery chute.

Next, the above-mentioned waste glass bottle color-classification apparatus according to the present invention will be further discussed.

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Waste glass bottles that are usually supplied in a random position are orientated to form a line with their longitudinal axes being directed in the advancing direction by an orientating means. Thereafter, the bottles are moved into the bucket conveyor. The buckets carrying the bottles advance downstream on the conveyor to reach a point A and/or B (shown in FIG. 1) where the bottle detecting sensor (or a load condition sensing means) senses the bucket for determining the bottle load condition. Furthermore, the bottle color discrimination means disposed at a further downstream point optically senses the bottle in the bucket. Thus obtained images are processed to discriminate the bottle color. The optical sensing for the bottle in the bucket by the bottle color discrimination means is operated based on the timing of an output signal supplied from the bucket sensor disposed at a point E (shown in FIG. 1). That is, optically sensing the bottle in the bucket based on the signal output timing of the bucket sensor allows the optical sensing to be adequately operated.

Furthermore, in the present invention, using the product of the output signal from the bucket sensor and the output signal from the bottle detecting sensor as a trigger for the optically sensing timing of the bottle enables to sense only the buckets carrying a bottle for color discrimination. Thus, it is not necessary to optically sense all the buckets for image processing. That is, based on the output signal from the bottle detecting sensor, optically sensing of the bottle is selectively operated, which improves a throughput speed of the apparatus.

However, after the insides of all the buckets are optically sensed based on the output timing of the bucket sensor, the bottle detecting sensor may sense the bottle loaded condition of the bucket. In this case, only the obtained images of the bucket carrying a bottle are processed for color

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discrimination. The bottom plate of the bucket that is determined to be in a bottle loaded condition by the bottle detecting sensor is opened at the delivery chute corresponding to the color determined by the color discrimination. Meanwhile, with respect to the bucket that is determined to be in an empty condition by the bottle detecting sensor, no image processing for color discrimination is operated in any of the foregoing cases. In addition, the bottom plate of the empty bucket is intentionally opened at of the delivery chute for receiving the remaining ones, so that colored cullets are controlled not to get mixed into delivery chutes for receiving colored bottles. Thus modified classification control method can prevent a decrease in the degree of color purity of the sorted glass bottles. It is easy to modify the control means for altering the classification control. Meanwhile, the bucket sensor may be disposed with little restriction, because the function of the sensor is only to know the timing of the pass of the bucket at a predetermined point.

Alternatively, the bottle color discrimination means optically senses all the buckets so that all the obtained images are processed for color discrimination. Furthermore, in the classification step, based on the measurement results of the bottle detecting sensor, the bucket that has been determined to be in a bottle loaded condition is opened at the delivery chute corresponding to the discriminated color of the bottle, and the bucket that has been determined to be in no load condition is opened at the delivery chute for receiving the remaining ones. This achieves the same effect as the aforementioned method. In addition, the bottle detecting sensor may be disposed at one of points A, B, C, and D positioned upstream from the delivery chute (see FIG. 1).

A furthermore object of the invention is to provide a waste glass bottle

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color-classification apparatus that can preclude standing bottles in the buckets. This can eliminate a wrong determination when the bottles in buckets transferred by a bucket conveyor are discriminated in color, allowing an improvement in the degree of color purity of classified glass bottles and preventing the apparatus from being damaged by the standing bottles, resulted in an improved availability of the apparatus.

For achieving the object, in a seventh configuration of the invention, a waste glass bottle color-classification apparatus comprising:

a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and

a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

wherein the presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery chute, and the color of a bottle that has not been determined to be a standing one is discriminated in color so that the bottle is classified to be discharged into a delivery chute corresponding to the color of the bottle.

In this apparatus, the standing bottles are recovered into the standing bottle delivery chute and the bottles are recovered separately in color with a high degree of purity in color of bottle.

In an eighth configuration of the invention, in addition to the seventh configuration, the apparatus further includes that the standing bottle having been discharged into the delivery chute is circulated by feeding the

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bottle on the bottle orientating means again.

In a ninth configuration of the invention, a waste glass bottle color-classification apparatus comprising:

- (a) a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle,
- (b) a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,
- (c) a bottle color discrimination means for discriminating the color of a bottle mounted on each bucket on the conveyor,
- (d) a plurality of delivery chutes disposed downstream from the bottle color discrimination means and under the bucket conveyor, each chute corresponding to each one of predetermined colors,
- (e) a standing bottle removal means for precluding a bottle in one of the buckets,
- (f) a bucket sensor for sensing the timing of the pass of each bucket on the conveyor, and
- (g) a separation means for discharging each bottle transferred by the bucket conveyor into the delivery chute corresponding to the bottle color.

This configuration has the standing bottle removal means for precluding standing bottles that may possibly be wrongly determined in the color discrimination, preventing such bottles from getting mixed with bottles different in color to improve the purity degree in color of classified bottles.

In a tenth configuration of the invention, in addition to the ninth configuration, the standing bottle removal means comprises:

(a) a standing bottle detecting sensor for sensing each transferred bottle to determine whether the bottle is standing in the bucket in an upstream side of the bottle color discrimination means,

(b) a standing bottle delivery chute positioned on the way from the standing bottle detecting sensor to the color discrimination means and under the bucket conveyor,

(c) a standing bottle removal means for discharging the standing bottle in the standing bottle delivery chute.

In this configuration, upwardly protruding bottles in the buckets are sensed by the standing bottle detecting sensor, so that the bottom plates of the buckets carrying the standing bottles is opened to preclude the standing bottles in the standing bottle delivery chute.

In an eleventh configuration of the invention, in addition to the ninth configuration, the standing bottle removal means can determine each bucket whether the bucket has a standing bottle based on both an output signal of the standing bottle detecting sensor and an output signal of the bucket sensor, and also can discharge the bottle into the standing bottle delivery chute by opening the bottom plates of the determined bucket and also by opening the bottom plates of a couple of buckets each positioned backward or forward adjacent to the determined bucket. This configuration can positively preclude such standing bottles.

In a twelfth configuration of the invention, in addition to the tenth configuration, the apparatus further includes that the standing bottle delivery chute has a container for receiving and storing the removed bottles or has a circulation device for returning the removed bottles

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upstream from the bottle orientating means. In this configuration, the standing bottles can be classified in color again by returning the bottles in an upstream side from the bottle orientating means.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic plan view showing a first embodiment of a waste glass bottle color-classification apparatus according to the present invention, which includes a control system;

FIG. 2A is a plan view of an orientating means in the first embodiment, and FIG. 2B is a sectional view taken along line A-A' in FIG. 2A;

FIG. 3 is a plan view showing a bucket conveyor in the first embodiment;

FIG. 4 is a side view showing the bucket conveyor in the first embodiment;

FIG. 5 is a sectional view showing the bucket conveyor in the first embodiment;

FIG. 6 is a timing diagram of outputs of sensors used in the embodiment and the related operations for classification;

FIG. 7 is another timing diagram of outputs of the sensors used in the embodiment and the related operations for classification;

FIG. 8 is a flow chart showing a control flow in a waste glass bottle color discrimination method according to the first embodiment;

FIG. 9 is a schematic plan view showing a second embodiment of the present invention;

FIG. 10 is an illustration for showing standing bottle loaded conditions related to the second embodiment;

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FIG. 11 is a control flow related to the second embodiment;

FIG. 12 is a plan view showing a modified example of the second embodiment;

FIG. 13 is a schematic plan view showing a known classification apparatus; and

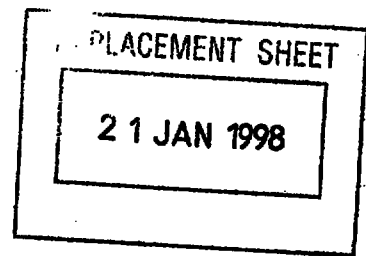
FIG. 14 is an illustration showing standing bottle loaded conditions related to the known classification apparatus.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A first embodiment

Referring to the accompanied drawings, embodiments of the waste glass bottle color-classification apparatus according to the present invention will be discussed hereinafter.

FIG. 1 is a diagrammatic illustration of an embodiment of a waste glass bottle color-classification apparatus according to the invention. The waste glass bottle color-classification apparatus includes an orientating conveyor 2 for orientating and transferring waste glass bottles 10 successively supplied from a bottle feeding conveyor 1 with the longitudinal direction of each bottle being in the conveyor advancing direction, a bucket conveyor 3 for receiving one by one the bottles 10 supplied from orientating conveyor 2 in its buckets, a bottle detecting sensor 4 for sensing the load condition of each bucket in respect of waste glass bottles 10, a bottle color discrimination means 5 for optically sensing waste glass bottle 10 in the bucket to discriminate the bottle color, a plurality of delivery chutes 6 for receiving bottles 10 separately in color, one of the chutes receiving the remaining bottles that can not be discriminated in color, a bucket sensor 7 for sensing its identification



number, and a control means 9 having a storage device 9g for memorizing the bucket load condition including bottle carrying conditions/no load condition of each bucket, and the discriminated color of the bottle together with the bucket identification number.

FIG. 2A is a plan view showing orientating conveyor 2 in the embodiment and FIG. 2B is a sectional view taken on line A-A' in FIG. 2A. The orientating conveyor 2 consists primarily of a conveyor 21 and a transfer guide 22. In the figures, θ denotes an inclination angle of conveyor 21 to a horizontal line. The angle θ is about 20° in the embodiment. α denotes an angle of the operation direction of transfer guide 22 to the traveling direction of conveyor 21 and is set at an angle of about 10° . β denotes an angle between conveyor 21 and transfer guide 22. The angle β is set at an angle of about 90° .

With the traveling of conveyor 21, bottles 10 are moved toward the lower side of conveyor 21 so that the spout portion or the bottom portion of bottle 10 makes contact with transfer guide 22. Since bottle 10 is in contact both with conveyor 21 and transfer guide 22 and transfer guide 22 is higher than conveyor 21 in operating speed, the spout portion or the bottom portion of bottle 10 is forcibly turned to orientate in the operating direction of transfer guide 22.

A main body portion of bottle 10 finally makes contact with the running guide 22, so that a main body side surface of bottle 10 orientates in the advance direction X_1 of running guide 22 to complete the orientation of bottle 10. In this embodiment, transfer conveyor 21 transfers in the direction of an arrow Y_1 , and running guide 22 transfers at a speed greater than in transfer conveyor 21. This can orientate and transfer at a high speed bottle 10 supplied on transfer conveyor 21, greatly decreasing

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the mutual abutment of the bottles. Thus, the breakage and noise caused by the abutment of the bottles can be decreased and the orientation of a high rate can be achieved.

Next, referring to FIGS. 3 to 5, an example of bucket conveyor 3 will be discussed. FIG. 3 is a plan view of the conveyor, which includes a control system thereof; FIG. 4 a side view; and FIG. 5 is an enlarged sectional view of the buckets of the conveyor. In FIGS. 3 and 4, bucket conveyor 3 has buckets 31 disposed at regular intervals and provided with bottles 10. The buckets 31 are mutually connected by chains 33 that engage with a sprocket wheel 36. The sprocket wheel 36 drives chains 33 to move buckets 31. Each bucket 31 is formed to receive one of the bottles in a perpendicular direction to the advance direction and has an openable bottom plate 32.

The bottom plate 32 of bucket 31, as shown in FIG. 5, is released based on a control signal supplied from a control means 9. In operation, an air cylinder 35 operates based on the control signal, upwardly moving the roller 39 to pivot a hooking piece 38 for the bottom plate in the direction of an arrow so as to release a free end of bottom plate 32 from hooking piece 38 by the force of a spring 40 connected both to a wall surface of bottom plate 32 and a wall surface of bucket 31. The released bottom plate 32 is upwardly moved to close again by a rail 37 provided at the forward end of the conveyor with the advancing of bucket 31.

Furthermore, bucket conveyor 3 has a bottle detecting sensor 4 for sensing each load condition of buckets 31 at an upstream point A (FIG. 1) of bucket conveyor 3, and has a bottle color discrimination means 5 including a CCD camera for sensing the inside of the bucket at a downstream point F the point (FIG. 1). At a further point E (FIG. 1) is

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disposed a bucket sensor 7. The bottle detecting sensor 4 can detect the load condition of bucket 31 in respect of a waste glass bottle. Bucket sensor 7 outputs a bucket detection signal when each bucket 31 pass a detection point. The bottle color discrimination means 5 identifies the color of bottle 10 mounted on each bucket 31 to output a corresponding color detection signal. The detection signals are received in the control means 9 that outputs control signals for classifying the bottles.

The classification of the waste glass bottles is based on control signals supplied from control means 9, which selectively operates the air cylinders 35 to open bottom plates 32 of buckets 31.

Waste glass bottles 10 are classified to be received in delivery chutes 6a to 6d based on the color of each bottle, and cullets are delivered into a delivery chute 6e for receiving the others. There are three types of load conditions of the buckets, which are a waste glass bottle loaded condition, no bottle loaded condition, and a cullet loaded condition. Bottle detecting sensor 4 can sense whether each bucket 32 is a bottle loaded condition or not. For bottle detecting sensor 4 is applied, for example, a reflector type optical sensor. Alternatively, a transmission optical sensor, a photoelectric switch, or an ultrasonic sensor may be used for sensing the presence or absence of a bottle 10 in each bucket 31. In addition, a plurality of sensors may be operably combined to sense the load condition of bucket 31.

Bucket sensor 7 is a position sensor for determining the position of each bucket 31. The bucket sensor generates a signal indicating the passing of each bucket, the signals being counted to determine the position of the bucket. For bucket sensor 7 is applied an optical sensor, but a proximity switch may be used if the bucket is made of metal. In addition, when an

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optical sensor is utilized, a reflecting tape may be put on a side surface of bucket 31, which provides an intensified reflected ray when the tape cross the front face of the optical sensor, allowing the detection of the passing of the bucket. Alternatively, an encoder may be applied for detecting the passing timing of the bucket.

Control means 9 consists of both a signal processing means including an image processing means and a CPU (central processing unit). Output from bottle detecting sensor 4 is supplied to control means 9 so that a loaded condition determination means 9a determines whether the bucket is in a bottle loaded condition or in no bottle loaded condition including a cullet loaded condition. Pictures taken by bottle color discrimination means 5 are image-processed to discriminate the bottle colors. The discrimination results are supplied to a color indication signal generating means 9b to output color indicating signals. In addition, bottle color discrimination means 5 operates synchronously with timing signals supplied from a sensing timing signal generating means 9c. The count means 9d can count the bucket passing signals supplied from bucket sensor 7. A delivery position determination means 9e combines a color indicating signal supplied from color discrimination signal generating means 9b with a related counted value by supplied by count means 9d to determine which one of air cylinders 35 will be operated. Storage means 9g stores in memory each bucket number, the corresponding bottle color, and the corresponding load condition. The bottles are classified based on the data stored in storage means 9g. When each bucket passes one of predetermined points, the classification codes of the related delivery chutes are compared with the corresponding data stored in storage means 9g. If the codes match the data, the classification control signal generating means 9f outputs a control

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signal to release bottom plate 32 of the bucket. Control means 9, for example, operates based on a control flow in a flow chart shown in FIG. 8.

Next, referring FIGS. 6 to 8, discrimination in color of the waste glass bottles and classification in load condition of the buckets with respect to the embodiment will be discussed in details.

FIGS. 6 and 7 are respectively a timing diagram showing an operation of the bottle color discrimination means.

The timing diagrams include the timing of the classification of the bottles. The classification separately delivers the bottles into a plurality of delivery chutes organized according to color or another delivery chute called by the code name of the others. In the timing diagram, load conditions of the buckets are classified into a waste glass bottle loaded condition, no load condition, and a cullet loaded condition.

In FIG. 6, item (a) denotes outputs of the bottle detecting sensor 4 positioned at point A. The sensor outputs a high level signal as corresponded to a bottle loaded condition of the bucket and outputs a low level signal as corresponded to no load condition or a cullets loaded condition of the bucket. The output of the bottle detecting sensor 4 is supplied to control means 9.

Item (b) in FIG. 6 denotes output waveforms of bucket sensor 7. When every bucket 31 moved by bucket conveyor 3 passes at a predetermined point, the bucket sensor outputs a pulse of a high level to input it into control means 9.

Item (c) in FIG. 6 denotes output waveforms of timing signals created by the products of outputs from bottle detecting sensor 4 and from bucket sensor 7 synchronously with outputs of bucket sensor 7 control means 9 creates the timing signals that are triggers to operate bottle color discrimination means 5.

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Item (d) in FIG. 6 shows conditions of color indicating signals of color discrimination signal generating means 9b. When the bucket is determined to be in a bottle loaded condition based on an output of bottle detecting sensor 4, the bottle color discrimination means 5 senses the bottle synchronously with the timing signal to discriminate the bottle color. When the bucket is determined to be in no load condition or in a cullet loaded condition, no picture will not be taken. Bottle color discrimination means 5 outputs signals into color discrimination signal generating means 9b to determine the color of the bottle in the bucket.

In item (e) of in FIG. 6, when the bucket is determined to be in a waste glass bottle loaded condition, bottom plate 32 of bucket 31 is released at a delivery chute 6 corresponding to the determined color of the bottle to classify the bottle to be received in delivery chute 6. For no load condition, bottom plate 32 of bucket 31 is released at delivery chute 6e of the others code. For a cullet loaded condition, like no load condition, the bottom plate of the bucket is released at delivery chute 6e of the others code to classify the cullets.

In a timing diagram of FIG. 7, item (a) illustrates outputs of bucket sensor 7; and item (b) illustrates timing signals synchronized with outputs of bucket sensor 7. Bottle color discrimination means 5 senses all the buckets synchronously with the timing signals to discriminate the bottles. In item (c), color discrimination signal generating means 9b indicates a color signal based on outputs of bottle color discrimination means 5, but no load conditions and a cullet loaded conditions are determined as the same condition as a colorless bottle loaded condition. Item (d) shows outputs of bottle detecting sensor 4, which indicates a bottle loaded condition or no load condition including a cullet loaded condition. When the output of the bottle

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detecting sensor is high in level, the bottle is delivered into a delivery chute 6 according to the color based on the output in item (c). Meanwhile, when the output of the bottle detecting sensor is low in level, the bucket is opened at the chute for the bucket of others code with disregarding the output in item (c).

Next, referring a flow chart of FIG. 8, a classification control flow of the bottles will be discussed. One of waste glass bottles is received one by one in each bucket on bucket conveyor 3 driven to transfer bottles (step S1). bucket sensor 7 senses every passing of bucket 31 to output a detection signal (step S2). Bottle detecting sensor 4 senses the load condition of each bucket 31 (step S3). Based on outputs of bottle detecting sensor 4, when bucket 31 is determined to be mounted with a waste glass bottle, the bottle in bucket 31 is sensed to discriminate the bottle color (step S4). Storage means 9g stores both the load condition and the color of the bottle corresponding to each bucket number (step S5). The load condition and the color of the bottle corresponding to each bucket number are read out from storage means 9g (step S6). The next step S7 starts a classification operation for delivering the bottles into delivery chutes 6a to 6d according to the bottle color, the bucket that is determined not to be in a glass bottle loaded condition is opened at delivery chute 6e of the others code.

In the classification operation, when a bucket reaches above the delivery chute 6a corresponding to a transparent colorless bottle, the load condition of the bucket is sensed. If the bucket is determined to be mounted with a transparent colorless bottle, the bucket bottom plate is opened. Meanwhile, when the bottle is not determined to be a transparent colorless bottle, the bucket is moved to above delivery chute 6b corresponding to a next color A to be determined whether the bottle color of

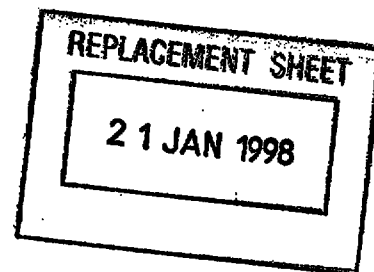
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the bucket is the same as the color A. If the determination is positive, the bucket bottom plate opens to deliver the bottle having the color A into chute 6b. Subsequently, the color of the bottle in another bucket above delivery chute 6a is determined.

As repeating such operation, the bucket advances one by one to reach step S8. In step S8, if the color in the bucket is not identified with any of colorless and the colors A to C, the process proceeds to step S9 that releases the bottom plate of the bucket and then the process proceeds to step S10. When the bucket of no load condition reaches delivery chute 6e of the others code, the no load condition is recognized and the process proceeds to step S9 that releases the bottom plate of the bucket and then the process proceeds to step S10. In step S10, the bottle color is determined whether it is identified with color C corresponding to delivery chute 6d. If the determination is positive, the process proceeds to step S11 to open the bottom plate and then proceeds to step S12. Step S12 determines whether the bottle color of the bucket is color B to deliver the bottle delivery chute 6c corresponding to color B at step S13. Similarly, steps S14 and S15 operate in respect of color A. The next step S16 determines whether the bottle is identified with a colorless one corresponding to transparent colorless bottle delivery chute 6a. If the determination is positive, the process proceeds to step S17 to open the bottom plate. The next step S18 determines the completion of the classification. If not completed, the process proceeds to step S19 that advances the buckets to repeat the operations in steps S8 to S19 in respect of a subsequent bucket. Thus, the bottles are classified according to the bucket load conditions and the bottle colors.

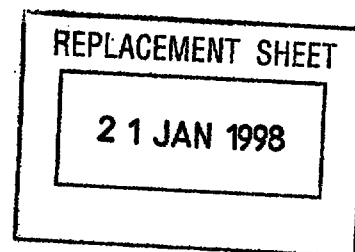
In this embodiment, a count means 9d counts signals supplied from



bucket sensor 7. Based on the counted value, delivery position determination means 9e defines the positions of the buckets of which that the bottle has been discriminated in color. When the bucket reaches the corresponding delivery chute 6, an air cylinder 35 disposed in a side of delivery chute 6 operate to move upward roller 39 in the direction of an arrow in FIG. 5 so that the bottom plate hooking piece 38 is pivoted in a substantially lateral direction shown in FIG. 5 to release the bottom plate. The compression force of spring 40 opens bottom plate 32, delivering the bottle 10 at the corresponding delivery chute 6. The opened bottom plate 32 is closed again at a further downstream position by the bottom plate closing rail 37 so that hooking piece 38 holds the bottom plate of bucket 31. In respect of the bucket being in one of the load conditions that includes waste glass bottle loaded conditions not corresponding to colorless or the colors A to C, no load condition, and a cullet loaded condition, the bucket the bottom plate 32 is opened at delivery chute 6e coded as the others. Even if the bucket is carrying cullets, the cullets are delivered into delivery chute 6e of the others code. This eliminates the purity decrease, which has been a disadvantage in the known waste glass bottle color-classification apparatus, in classified colorless bottles.

Irrespective of outputs of bottle detecting sensor 4, pictures may be taken in respect of all the buckets to discriminate the color of the taken images. Even in that case, in respect of the bucket being in one of the load conditions that includes bottle loaded conditions not corresponding to colorless or colors A to C, no load condition, and a cullet loaded condition, the bucket bottom plate is opened at delivery chute 6e of the others code based on outputs from the bottle detecting sensor.

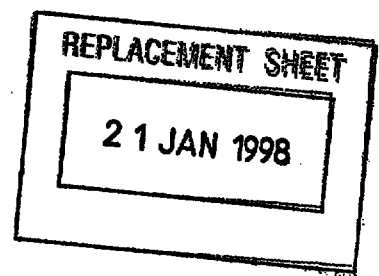
An operational effect of the embodiment will be discussed hereinafter.



As discussed above, in the bottle color-classification, in respect of a bucket being in no load condition, the bucket bottom plate is controlled to open not at the delivery chute corresponding to colorless bottles but at the delivery chute of the others code. Accordingly, colored cullets are not delivered into the delivery chute for receiving colorless bottles, greatly improving the purity of classified waste glass bottles, particularly of colorless glass bottles by the bottle color-classification.

A second embodiment

Referring accompanied drawings, a second embodiment of a waste glass bottle color-classification apparatus according to the present invention will be discussed hereinafter. FIG. 9 is a diagrammatic illustration of a waste glass bottle color discrimination apparatus including a control means according to the second embodiment of the invention. In FIG. 9, the bottle color discrimination apparatus includes a bottle feeding conveyor 1 delivered with waste glass bottles 11 from an in-size classification means such as a roller conveyor, a bottle orientating conveyor 2 for orientating the bottles delivered from the bottle feeding conveyor 1, a bucket conveyor 3 for receiving the bottles having been orientated by the bottle orientating conveyor 2 with the longitudinal direction of each bottle being perpendicular to the longitudinal direction of conveyor 3, a standing bottle detecting sensor 104 disposed at point A of bucket conveyor 3, a color discrimination means 5 positioned at a point as high as a middle height of bucket conveyor 3, a plurality of delivery chutes 6 disposed under bucket conveyor 3 for receiving the bottles according to their color, a bucket sensor 7 for recognizing the position of the bucket, a standing bottle delivering chute 8, and a circulation means 9 composed of belt conveyors or the like for transferring the bottles delivered in the standing bottle

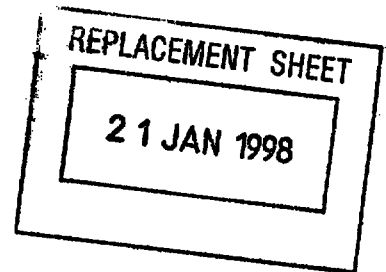


delivering chute 8 to bottle feeding conveyor 1. Based on signals from control means 12, color-classification of the bottles and discharging of the standing bottles are handled by releasing devices 35a to 35d such as an air cylinder. The color discrimination means 5 is disposed at a height suitable for sensing the bottle in each bucket.

Moreover, this embodiment includes a standing bottle detecting sensor 104 disposed at point A upstream from the color discrimination means 5. Bucket sensor 7 is disposed at point C. The standing bottle detecting sensor 104 detects whether each bucket has a bottle in a standing position within the bucket.

In this embodiment, the bottle color discrimination apparatus is controlled by a control means 12. The control means 12 performs image processing of image signals of each waste glass bottle taken in the longitudinal direction of the bottle by color discrimination means 5 to discriminate the bottle color. At the same time, control means 12 receives signals from bucket sensor 7 that generates a signal every when bucket 31 passes a predetermined point. Thus, the position of each bucket 31 is known by a count means for counting the signals from bucket sensor 7. The color of the bottle is recognized together with the corresponding bucket number as well as the first embodiment. In addition, standing bottle detecting sensor 4 detects whether the bottle in each bucket 31 is in a standing position. Base on the detection, air cylinders 35a to 35d operates for removal of such standing bottles and for classification in color of the bottles.

Next, referring FIG. 10, a method for detecting standing bottles in the buckets will be discussed in details. A single waste glass bottle is supplied in each bucket 31 to lie down therein, but the supplied bottle may

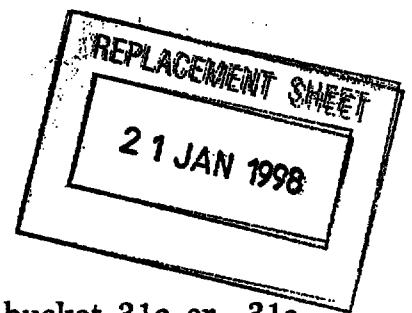


become unintentionally in a standing position. The standing bottle loaded condition is sensed by standing bottle detecting sensor 4. For standing bottle detecting sensor 4 is applied, for example, a reflector type optical sensor. Alternatively, a transmission optical sensor, a photoelectric switch, an ultrasonic sensor or a limit switch may be used. In addition, standing bottle detecting sensor 4 is not necessarily disposed at point A but may be positioned at point B in FIG. 9.

A standing bottle, as shown in FIG. 10, is standing in bucket 31 with the spout portion being extending above the side plates of bucket 31. Therefore, standing bottle detecting sensor 4 is adjusted so that a light optical axis of the sensor 4 passes slightly above the side plates of bucket 31. Thus, when the standing bottle 11a mounted on the bucket crosses the optical axis, the optical intensity is changed, allowing to detect a standing bottle loaded condition of the bucket.

The spout portion of the bottle 11a may extend over a bucket 31a or 31c adjacent to bucket 31b having standing bottle 11a. In such a case, the optical axis of the standing bottle detecting sensor 4 is positioned at a height shown by a chain line L₁. When the bucket is moved in the direction shown by an arrow, the standing bottle detecting sensor 4 detects the presence of a standing bottle at point D₁ or D₂. Thus, based on signals from the standing bottle detecting sensor 4, it is determined that bucket 31a or 31c has a standing bottle. Even if the optical axis of the standing bottle detecting sensor 4 is lowered at the height of a dotted line L₂, the presence of a standing bottle would be detected at point D₃ or D₄. Thus, it is determined that there is a standing bottle in bucket 31c or 31b.

Accordingly, when the standing bottle detecting sensor 4 is positioned



at the height of L_1 , it is wrongly determined that bucket 31a or 31c has a standing bottle 11a, so that the bottom plate of bucket 31a or 31c is opened but a standing bottle 11a in bucket 31b is not removed to be transferred downstream. To eliminate the drawback, the bottom plates of three buckets that are a bucket determined to be loaded with a standing bottle and a couple of buckets backward or forward adjacent to the determined bucket. This can positively remove a standing bottle 11a.

Next, a method for defining ongoing positions of the transferred buckets will be discussed in details.

In the embodiment, when the bucket sensor disposed at point C outputs a signal by perceiving a bucket, a color discrimination means 5 simultaneously senses a waste glass bottle in a bucket 31. At the same time, counting of the number of passing buckets starts for defining the positions of the buckets. That is, bucket sensor 7 is required only to detect the timing when each bucket 31 pass a predetermined point. The distance from the standing bottle detecting sensor to delivery chute 8 is predetermined as a multiple of the interval length of the bucket row. Similarly, the distance from the color discrimination means to delivery chute 6 is predetermined. Thus, after the standing bottle detecting sensor 4 outputs a signal by perceiving a standing bottle 11a, the timing when the bucket having a standing bottle 11a passes just above delivery chute 8 is known by bucket sensor 7 that can count the number of buckets passing point C. Based on this information, the bottom plate of the bucket opens to deliver the standing bottle 11a into delivery 8 to remove it.

Furthermore, referring a control flow in FIG. 11, an operation for removing standing bottles 11a will be discussed. The waste glass bottle in-color discrimination apparatus discriminates waste glass bottles in

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color to classify the waste bottles in color. In this operation, for example, when a waste glass bottle in a bucket is determined to be of color A, the bottle is recovered in a delivery chute for receiving waste glass bottles of color A by opening the bottom plate of the bucket to classify the bottles when the bucket reach above the delivery chute. In step S20, when the standing bottle detecting sensor 4 detects the presence of a standing bottle, a standing bottle removal program shown by a control flow in FIG. 7 starts to remove a standing bottle. Step S21 stores in memory the number of the bucket having a standing bottle.

Step S22 counts pulses generated by bucket sensor 7 according to the passing of the buckets to know when the bucket having the standing bottle reaches delivery chute 8. Step S23 releases the bottom plate of a bucket forward adjacent to the bucket that has been determined to have a standing bottle at delivery chute 8. In the next step S24, as shown in FIG. 9, the standing bottle is transferred from delivery chute 8 to be delivered in bottle feeding conveyor 1 by way of circulation means 9, as shown by arrows A3, A4, and A5.

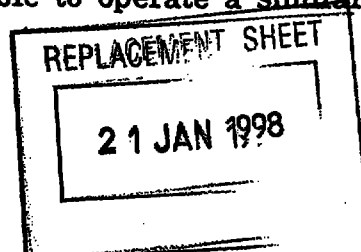
In the next step S24, when the bucket that has been determined to have a standing bottle reaches delivery chute 8, the bottom plate of the bucket opens to deliver a standing bottle, if present, into a delivery chute 8. Similarly, the bottle is supplied again into the bottle feeding conveyor 1 by way of circulation means 9.

In the next step S25, when a bucket backward adjacent to the bucket that has been determined to have a standing bottle reaches delivery chute 8, the bottom plate of the bucket opens to deliver a standing bottle, if present, into a delivery chute 8. Similarly, the bottle is supplied again into bottle feeding conveyor 1 by way of circulation means 9.

These steps for handling standing bottles can positively remove standing bottles to complete the removal process. Then, when the main program determines that the standing bottle detecting sensor 4 has detected the presence of a standing bottle base, the standing bottle removal program starts again.

Meanwhile, a bucket 31 having a waste glass bottle 11 in a normally loaded condition passes without responding to both the standing bottle detecting sensor 4 and the bottom plate releasing device. The downstream color discrimination means 5 discriminates bottle 11 in color. Then, the bucket 31 advances further downstream to reach the classification means. Based on the color determination of the bottle by color discrimination means 5, the bottom plate of the bucket opens at delivery chute 6 to separately recover the bottles 11 according to their colors. Like the standing bottle removal step, by counting pulses generated by bucket sensor 7, the position of a bucket 31 having a bottle 11 that has been discriminated in color is stored in memory. Thus, when the bucket reaches delivery chute 6, the bottle is correctly recovered by the releasing device for the bucket bottom plate.

Thus, by removing standing bottles upstream from color discrimination means 5, color discrimination means 5 would not sense a label-covered bottle side body, thereby preventing the purity decrease in color of recovered waste glass bottles to eliminate the aforementioned drawback in the known classification method. In addition, if the standing bottle detecting sensor is disposed at least upstream from the classification means for separately recovering bottles according to their colors and the standing bottle delivering chute is positioned downstream from the standing bottle detecting sensor, it is possible to operate a similar classification only by



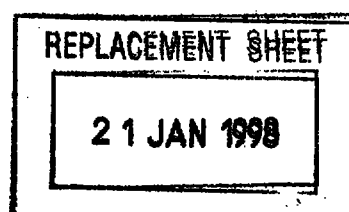
modifying the control method of the control means 12.

FIG. 12 is a schematic illustration showing a waste glass bottle color discrimination apparatus according to a further embodiment modified from the second embodiment of the present invention. The apparatus includes a releasing device disposed downstream from color discrimination means 5 for releasing the bottom plates of the buckets.

The standing bottle detecting sensor 4 senses the presence or absence of a standing bottle, and then color discrimination means 5 discriminates the bottles in color. Delivery chute 8 is located adjacent to delivery chute 6. Above delivery chute 8 is arranged releasing device 35a. The other constructions are the same as the second embodiment shown in FIG. 9. However, the standing bottles having been delivered into delivery chute 8 for circulation may be accumulated to define a predetermined amount before delivered in bottle feeding conveyor 1.

Furthermore, sensing of standing bottles and color discriminating of bottles may be simultaneously performed at point A. The obtained information are forwarded to a storage means of control means 12 that controls removal of the standing bottles and classification of the bottles in color.

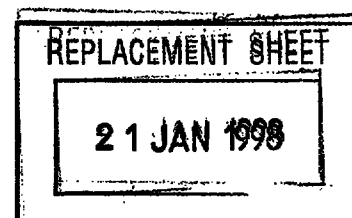
As mentioned above, in the bottle color discrimination apparatus according to the second invention, the orientating means can orientate waste glass bottles, which are delivered as randomly oriented bottles, in the transfer direction to form a line. Then, the bottles are moved into the bucket conveyor. When a bottle lies in its normal position, the color discrimination means can sense the bottle to discriminate it in color. If the bottle becomes in a standing condition at the moment of the transfer to the bucket conveyor, the standing bottle detecting sensor senses the



standing bottle loaded condition and at the same time the standing bottle detecting sensor starts to count signals from the bucket sensor to know the number of passing buckets. When the counted number becomes equivalent to the distance from point A related to the standing bottle detecting sensor to the position of the standing bottle delivering means, the bucket bottom plate opens to remove the standing bottle into the delivery chute.

In addition, the standing bottle is rarely standing in a vertical position and is usually in a slanting position so as to lean against a side wall of the bucket. Thus, in respect of a long waste glass bottle, the standing bottle detecting sensor may recognize that the standing bottle is mounted in a bucket forward or backward adjacent to the standing bottle loaded bucket. Accordingly, the standing bottle is not positively removed only by opening the bucket that has been recognized by the standing bottle detecting sensor. Thus, when the standing bottle detecting sensor has detected the presence of a standing bottle, the bottom plates of three buckets that are a bucket determined to be loaded with a standing bottle and a couple of buckets forward or backward adjacent to the determined bucket to positively remove the standing bottle. The standing bottle delivered into the delivery chute is fed again in an upstream of the orientating means by way of the circulation means to minimize the decrease in the handling amount of waste glass bottles due to the standing bottle removing device.

In the second embodiment, an optical sensor is applied for the bucket sensor, but alternatively a proximity detector may be applied for a metal bucket. In addition, when an optical sensor is utilized, a reflecting tape may be put on a side surface of the bucket, which provides an intensified reflected ray when the tape crosses the front face of the optical sensor, allowing the detection of the passing of the bucket. Alternatively,

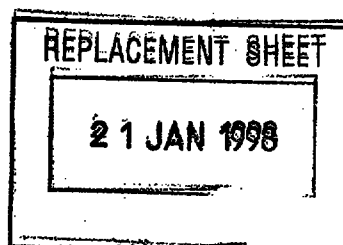


an encoder may be applied for detecting the passing timing of the bucket without limited by the description of the embodiment.

Furthermore, each bucket may be provided with an identification mark that can be sensed by the bucket sensor. Together with the mark, each bucket load condition including a standing bottle loaded condition and the color of the bottle are stored in memory for classification of the bottle.

Moreover, the in-size classification means (the roller conveyor) and the bottle orientating conveyor is not limited by the embodiment, but various types of known similar devices can be used alternatively. But, considering the rates of the classification and the orientation, those of the above-mentioned embodiment are preferable.

In addition, the second embodiment can remove the standing bottles s, eliminating breakage of equipment surrounding the bucket that may abut against the standing bottle. This eliminates an operation stop due to the breakage to improve the operation rate of the apparatus,





What is claimed is:

1. A waste glass bottle color-classification method comprising the steps of:

feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

sensing the load condition of the bucket,

optically sensing the waste glass bottle in the bucket to discriminate the bottle color,

discharging the waste glass bottle having been determined in color into a delivery chute corresponding to the determined color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining bottles that have not been discriminated in color.

2. A waste glass bottle color-classification method comprising the steps of:

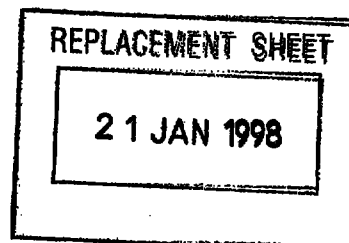
feeding a waste glass bottle in each of a plurality of buckets on a bucket conveyor,

optically sensing the inside of the bucket by a bottle detecting sensor to determine the load condition of the bucket,

sensing only the bucket that has been determined to be in a bottle loaded condition to discriminate the bottle color,

discharging the discriminated bottle into a delivery chute corresponding to the bottle color to classify the bottle, and

opening a bottom plate of the bucket which has been determined to be in no load condition at a delivery chute for receiving the remaining





bottles that have not been discriminated in color.

3. A waste glass bottle color-classification apparatus comprising:
a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles supplied in the buckets,

a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color,

a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color,

a bucket sensor for sensing the pass of the bucket on the conveyor, and

a load condition determination means for sensing the load condition of each bucket on the conveyor,

wherein the load condition determination means can output a signal indicating the empty condition of a bucket so as to open a bottom plate of the bucket at the chute for receiving the remaining bottles.

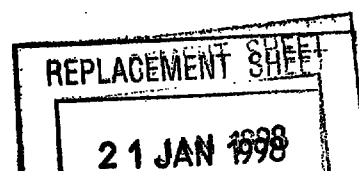
4. A waste glass bottle color-classification apparatus comprising:

(a) a bottle orientating means for orientating each waste glass bottle in its longitudinal direction,

(b) a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles each supplied in one of the buckets from the bottle orientating means in a perpendicular direction to the longitudinal direction of the bottle,

(c) a bottle color discrimination means for sensing the color of each waste glass bottle supplied in the bucket on the conveyor,

(d) a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to





the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, the chutes being positioned downstream from the bottle color discrimination means and under the bucket conveyor,

(e) a bottle detecting sensor for determining the presence or absence of a waste glass bottle in the bucket,

(f) a bucket sensor for generating a signal to measure a timing when each bucket on the conveyor passes a relative predetermined point,

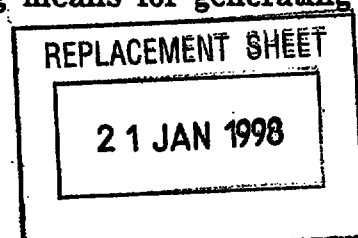
(g) a control means for classifying in color each bottle transferred by the bucket conveyor based on outputs each from the bottle detecting sensor, the bottle color discrimination means, and the bucket sensor, the control means generating a control signal to open both a bottom plate of the bucket which has been determined to be in no load condition by the bottle detecting sensor and a bottom plate of the bucket which can not be discriminated in color at the delivery chute for receiving the remaining bottles.

5. An apparatus as claimed in claim 3 or 4, the bottle color discrimination means disposed in the upper stream of the bucket conveyor can optically sense the inside of the bucket to detect the color of each bottle in synchronization with the pass of the bucket having a bottle with using a trigger timing signal that is obtained from a product of a detected signal of the bottle detecting sensor and a detected signal of the bucket sensor.

6. An apparatus as claimed in claim 4, said control means comprises:

a load condition determination means for determining the load condition of the bucket based on a signal sensed by the bottle detecting sensor,

a bucket detection signal generating means for generating a bucket





detection signal based on a signal sensed by the bucket sensor during the pass of the bucket,

an optically sensing timing signal generating means for generating a timing signal based on a product of outputs from both the bucket detection signal generating means and the load condition determination means,

a color discrimination signal generating means for discriminating the color of the bottle based on an output from the bottle color discrimination means, and

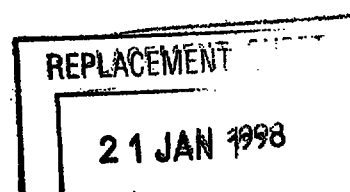
a classification control signal generating means for receiving signals supplied from the bucket detection signal generating means to generate a control signal for opening a bottom plate of a bucket carrying a bottle having a predetermined color and of a bucket carrying no bottle respectively at the corresponding delivery chute.

7. A waste glass bottle color-classification apparatus comprising:

a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and

a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

wherein the presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery chute, and the color of a bottle that has not been determined to be a standing one is discriminated in color so that the bottle is classified to be discharged into a delivery chute corresponding to the color of the bottle.





8. An apparatus as claimed in claim 7, wherein the standing bottle having been discharged into the delivery chute is circulated by feeding the bottle on the bottle orientating means again.

9. A waste glass bottle color-classification apparatus comprising:

(a) a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle,

(b) a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means and for transferring the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate,

(c) a bottle color discrimination means for discriminating the color of a bottle mounted on each bucket on the conveyor,

(d) a plurality of delivery chutes disposed downstream from the bottle color discrimination means and under the bucket conveyor, each chute corresponding to each one of predetermined colors,

(e) a standing bottle removal means for precluding a bottle in one of the buckets,

(f) a bucket sensor for sensing the timing of the pass of each bucket on the conveyor, and

(g) a separation means for discharging each bottle transferred by the bucket conveyor into the delivery chute corresponding to the bottle color.

10. An apparatus as claimed in claim 9, wherein the standing bottle removal means comprises:

(a) a standing bottle detecting sensor for sensing each transferred bottle to determine whether the bottle is standing in the bucket in an

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upstream side of the bottle color discrimination means,

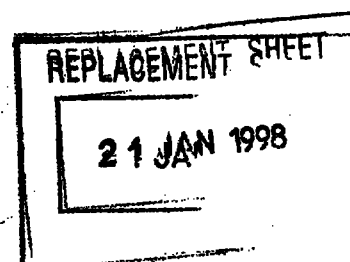
(b) a standing bottle discharging chute positioned on the way from the standing bottle detecting sensor to the color discrimination means and under the bucket conveyor,

(c) a standing bottle removal means for discharging the standing bottle in the standing bottle delivery chute .

11. An apparatus as claimed in claim 9, wherein

the standing bottle removal means can determine each bucket whether the bucket has a standing bottle based on both an output signal of the standing bottle detecting sensor and an output signal of the bucket sensor, and also can discharge the bottle into the standing bottle delivery chute by opening the bottom plates of the determined bucket and also by opening the bottom plates of a couple of buckets each positioned backward or forward adjacent to the determined bucket .

12. An apparatus as claimed in claim 10 or 11, wherein the standing bottle delivery chute has a container for receiving and storing the removed bottles or has a circulation device for returning the removed bottles upstream from the bottle orientating means.



WASTE GLASS BOTTLE COLOR-CLASSIFICATION METHOD AND
APPARATUS OF THE SAME

ABSTRACT OF THE DISCLOSURE

A waste glass bottle color-classification apparatus includes a bucket conveyor having a plurality of buckets each with an openable bottom plate and transferring waste glass bottles supplied in the buckets, a bottle color discrimination means for optically sensing a waste glass bottle supplied in the bucket to discriminate the bottle color, a plurality of delivery chutes for discharging the bottles and for separating the bottles respectively into one of the chutes corresponding to the bottle color or into a chute for receiving the remaining bottles that can not be discriminated in color, a bucket sensor for sensing the pass of the bucket on the conveyor, and a load condition determination means for sensing the load condition of each bucket on the conveyor. Another waste glass bottle color-classification apparatus includes a bottle orientating means for orientating a plurality of waste glass bottles in the longitudinal direction of each bottle, and a bucket conveyor having a plurality of buckets each of which can receive one of the bottles supplied from the bottle orientating means to transfer the bottles substantially in a perpendicular direction to the longitudinal orientated direction of the bottles, each bucket having an openable bottom plate. The presence or absence of a bottle standing in each bucket is sensed during the transfer by the conveyor to preclude the bottle that is determined to be a standing bottle by discharging the bottle into a delivery chute.

Figure 9

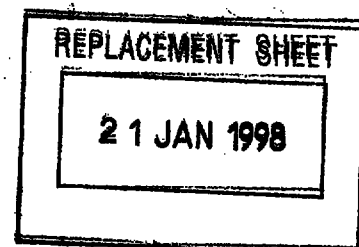


FIG. 1

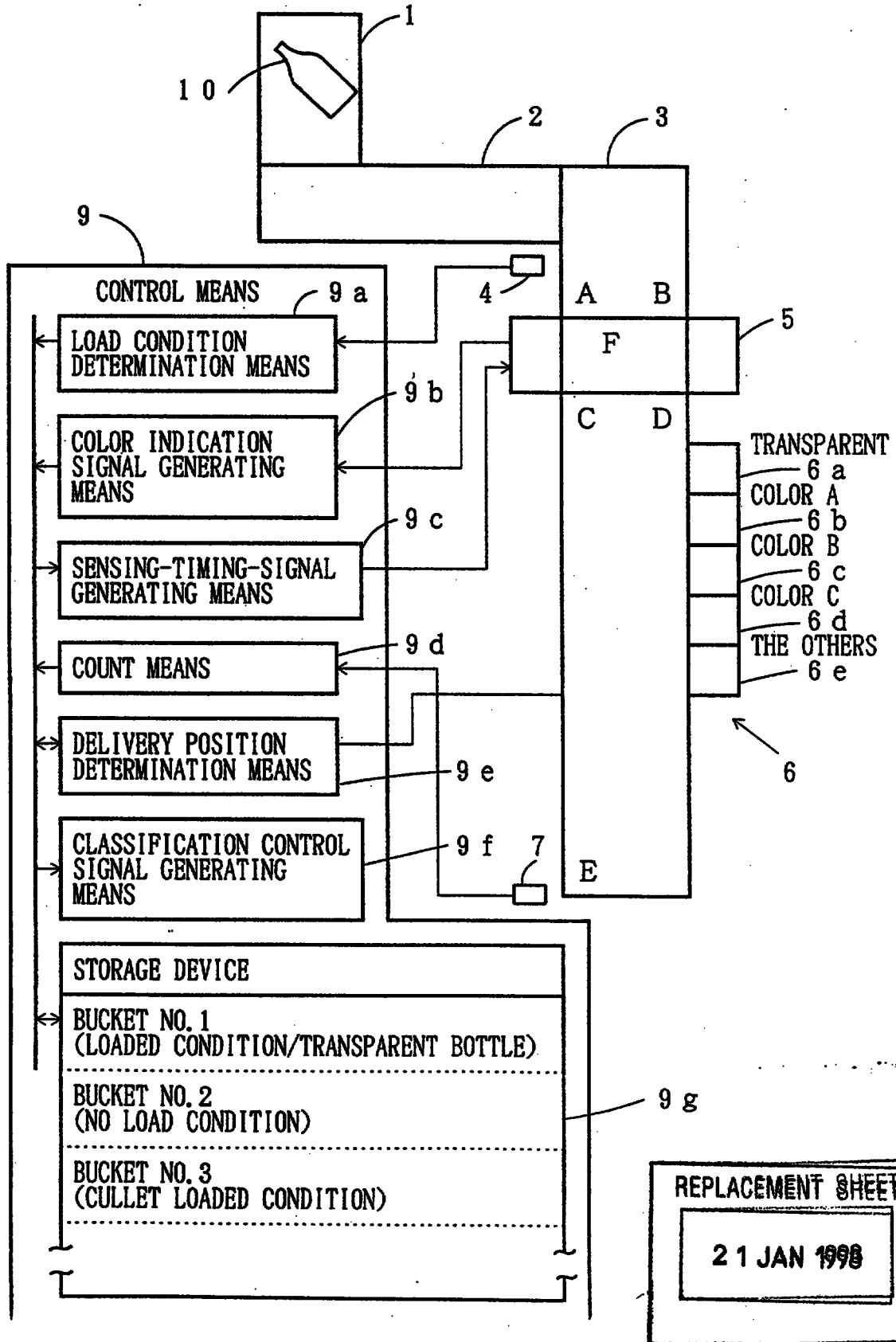


FIG. 2A

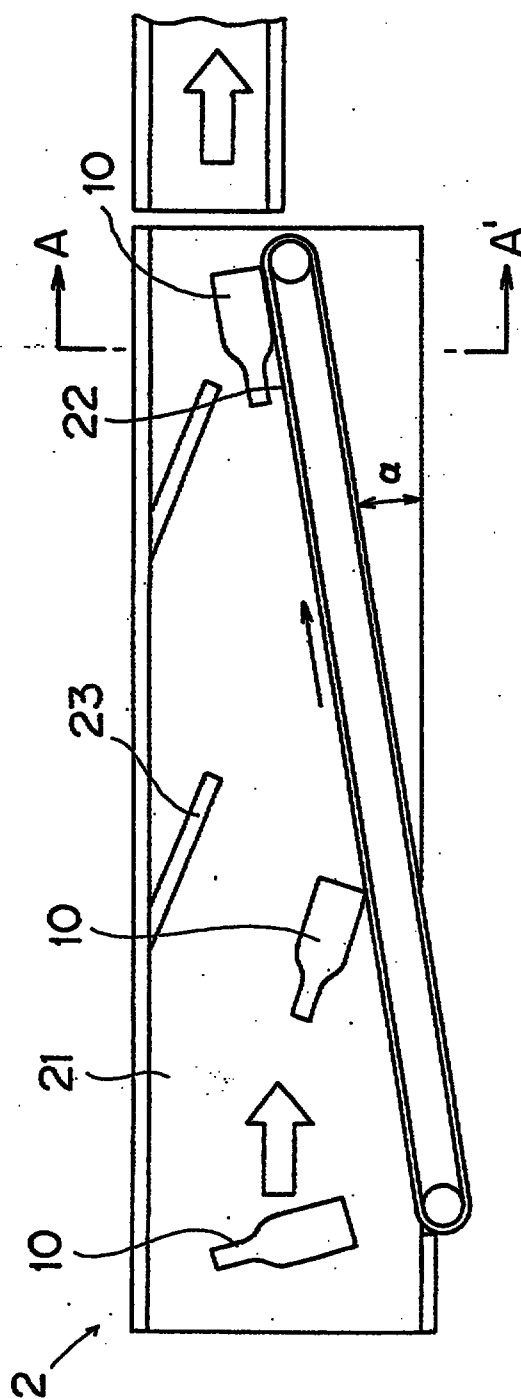
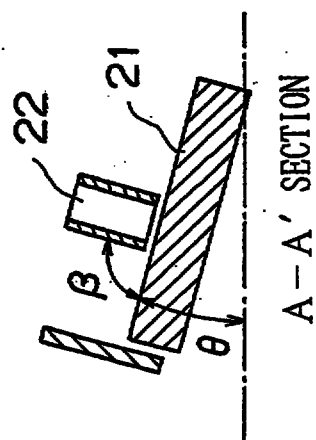


FIG. 2B



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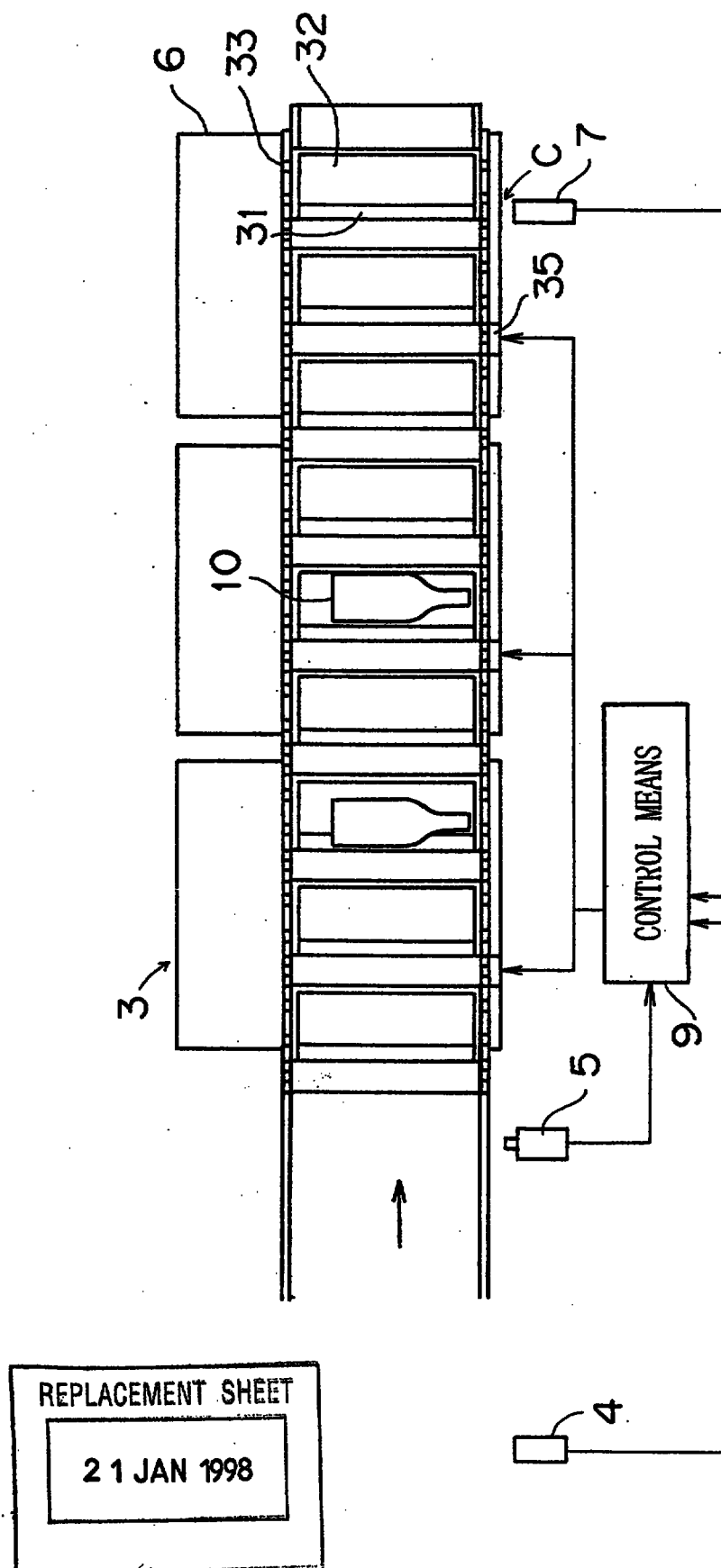
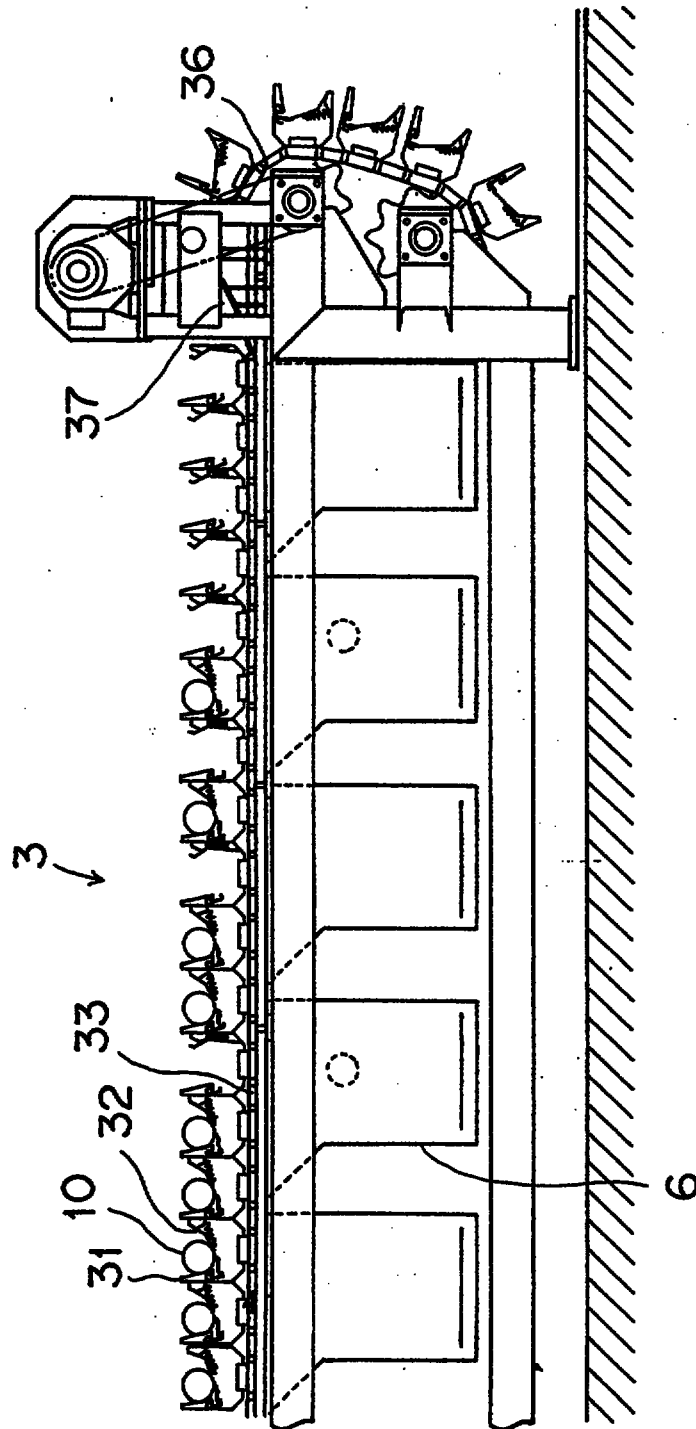


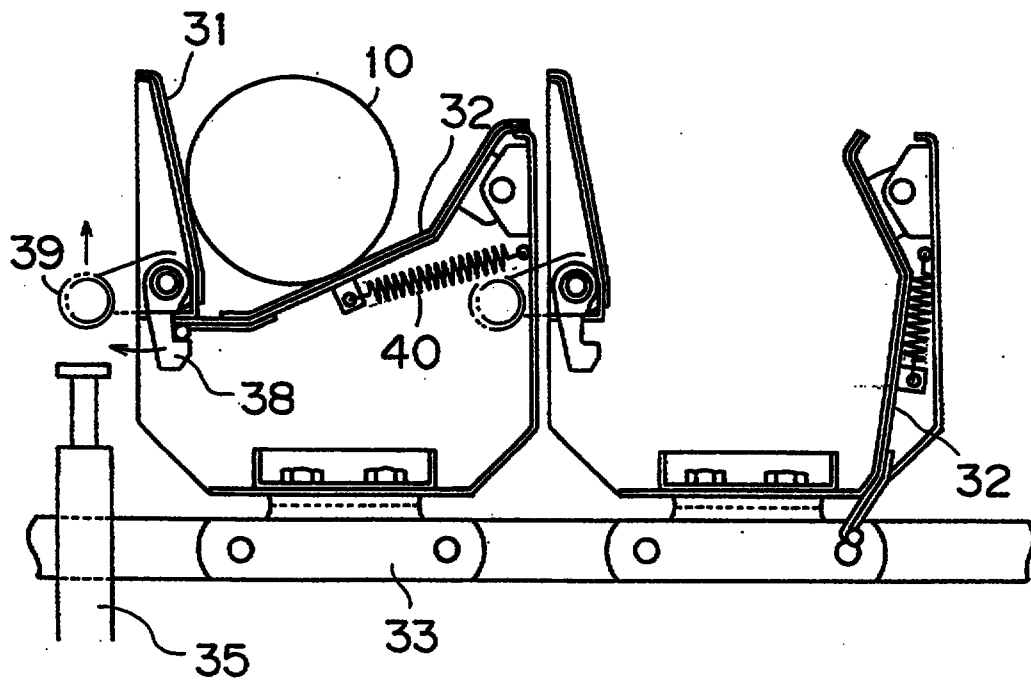
FIG. 4



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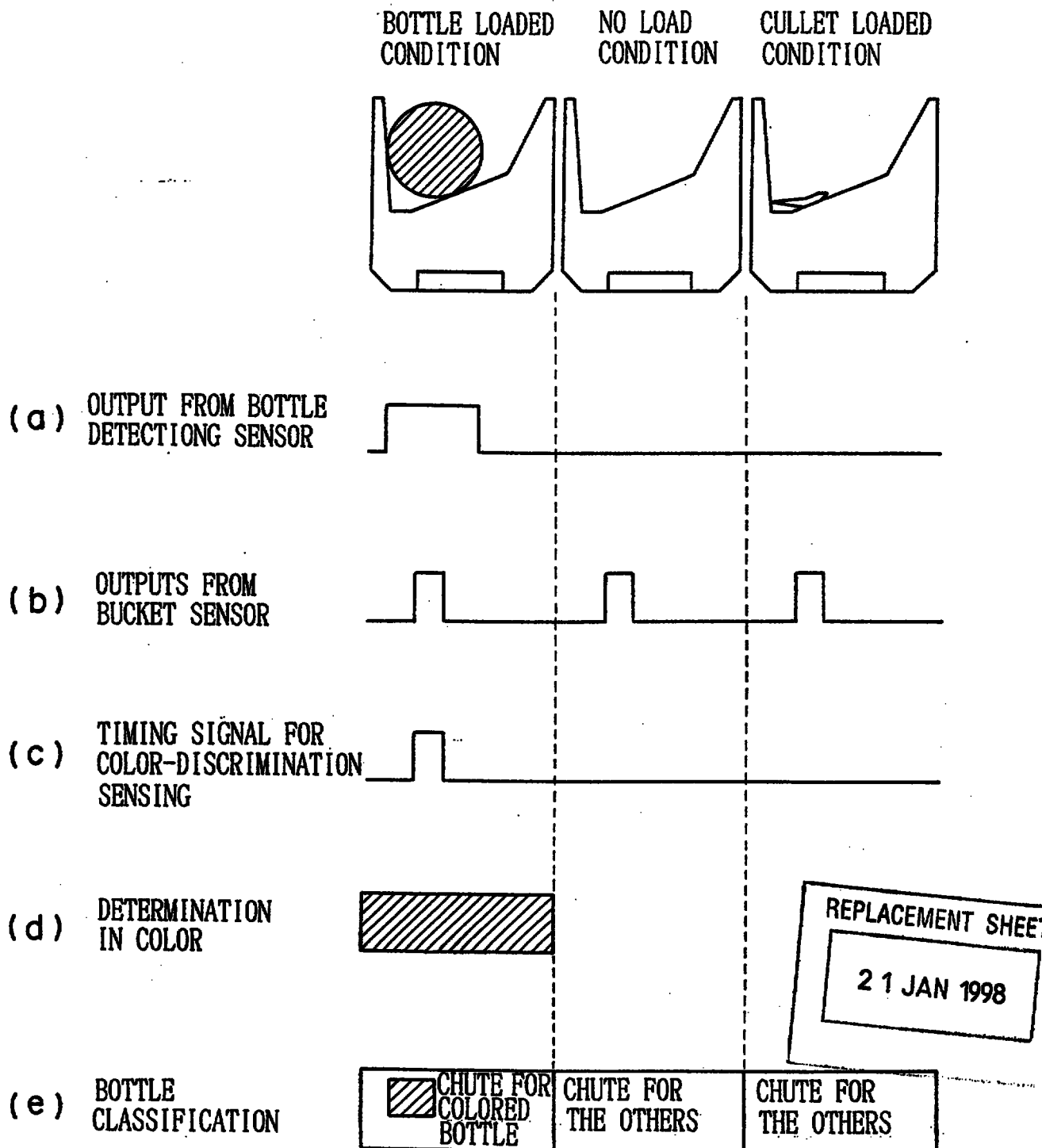
FIG. 5



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FIG. 6



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FIG. 7

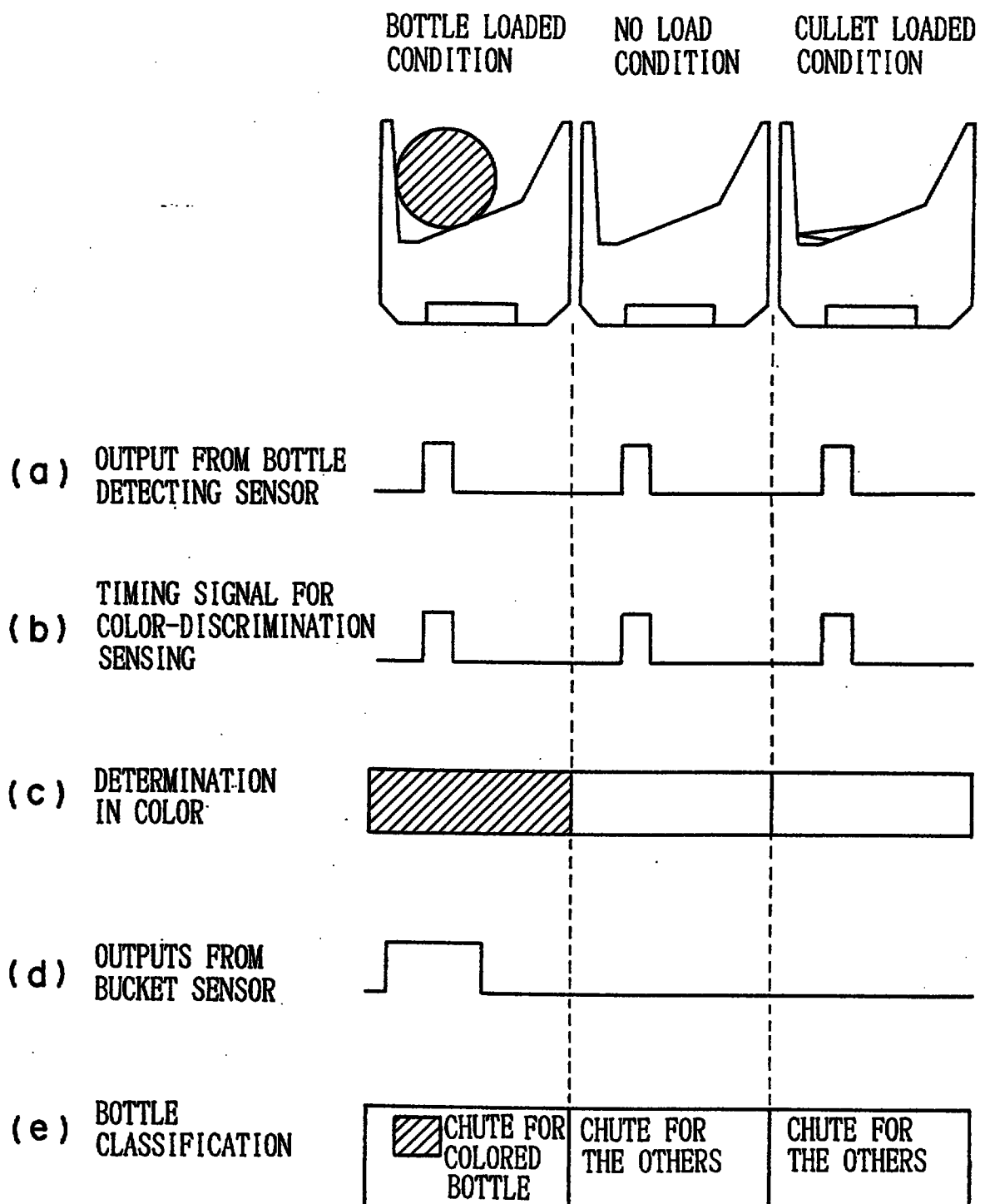
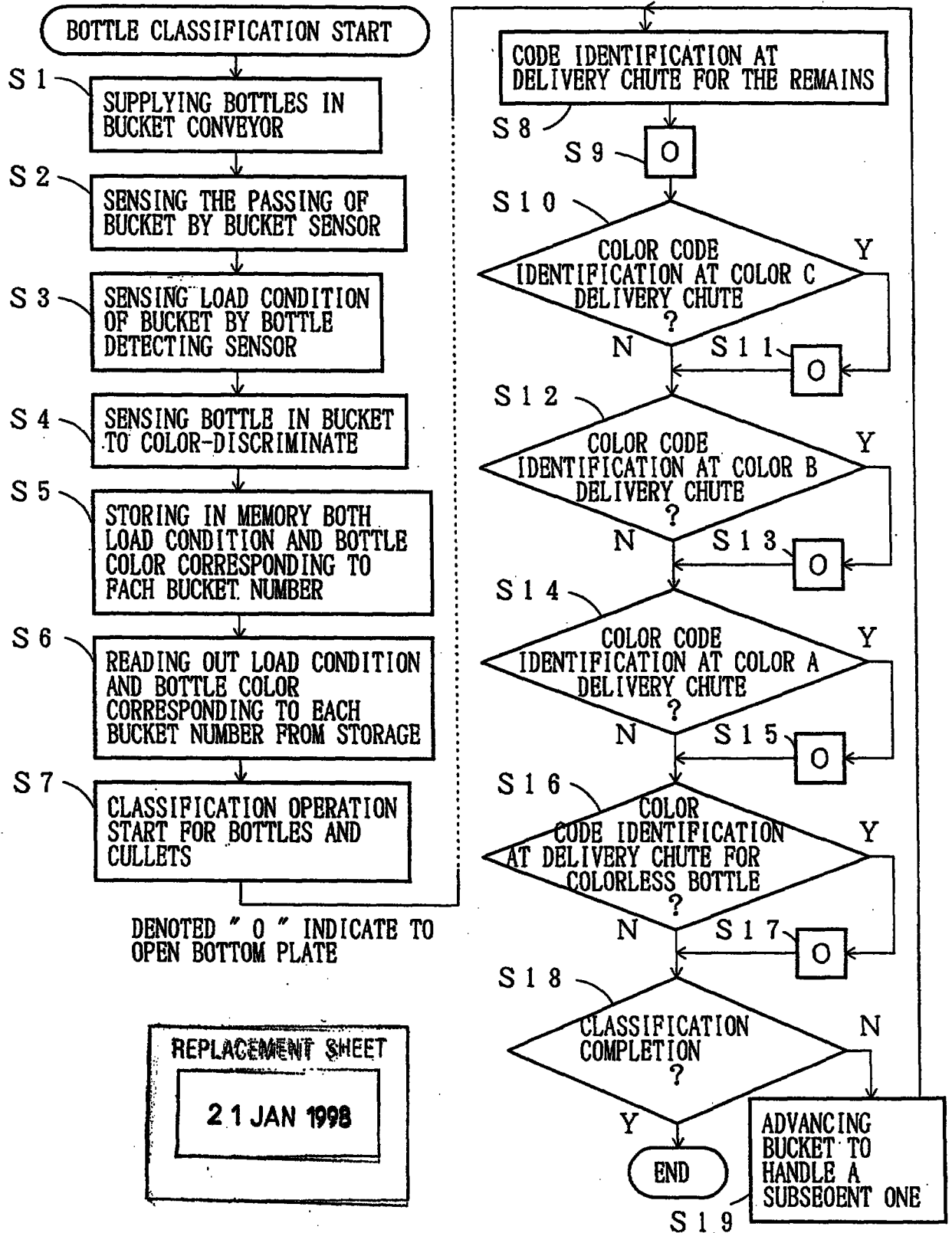


FIG. 8



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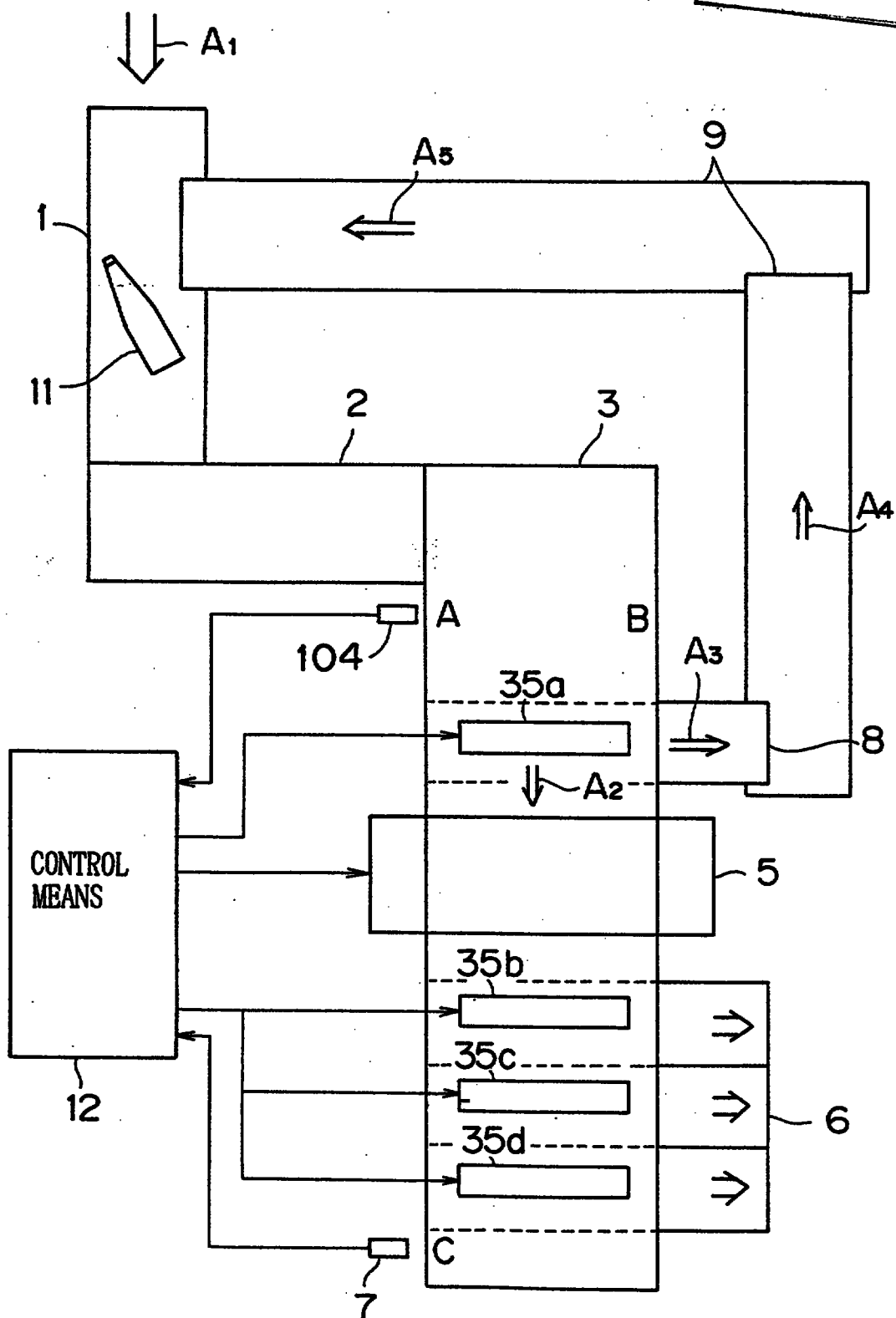


FIG. 10

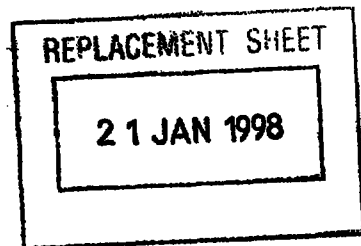
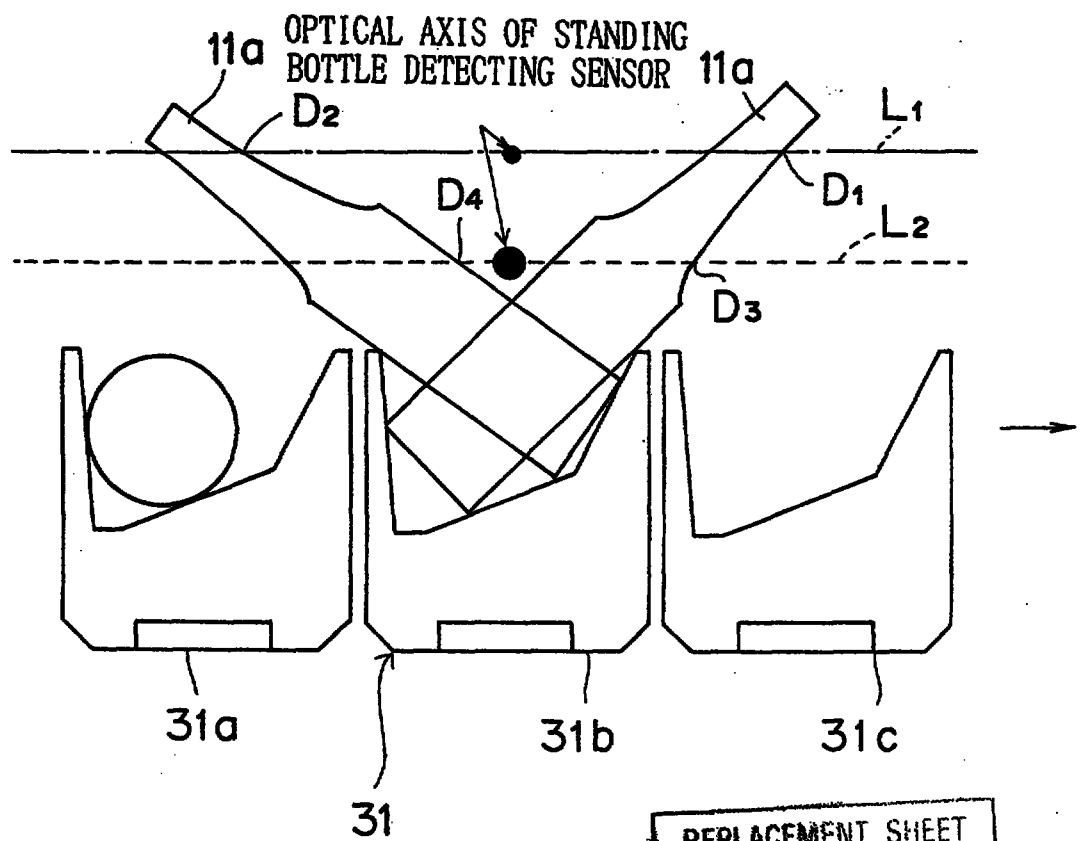


FIG. 11

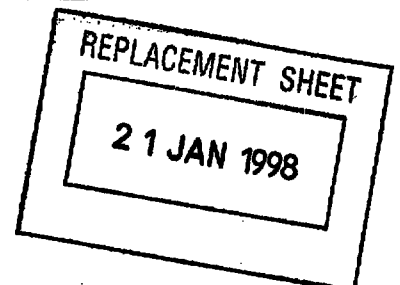
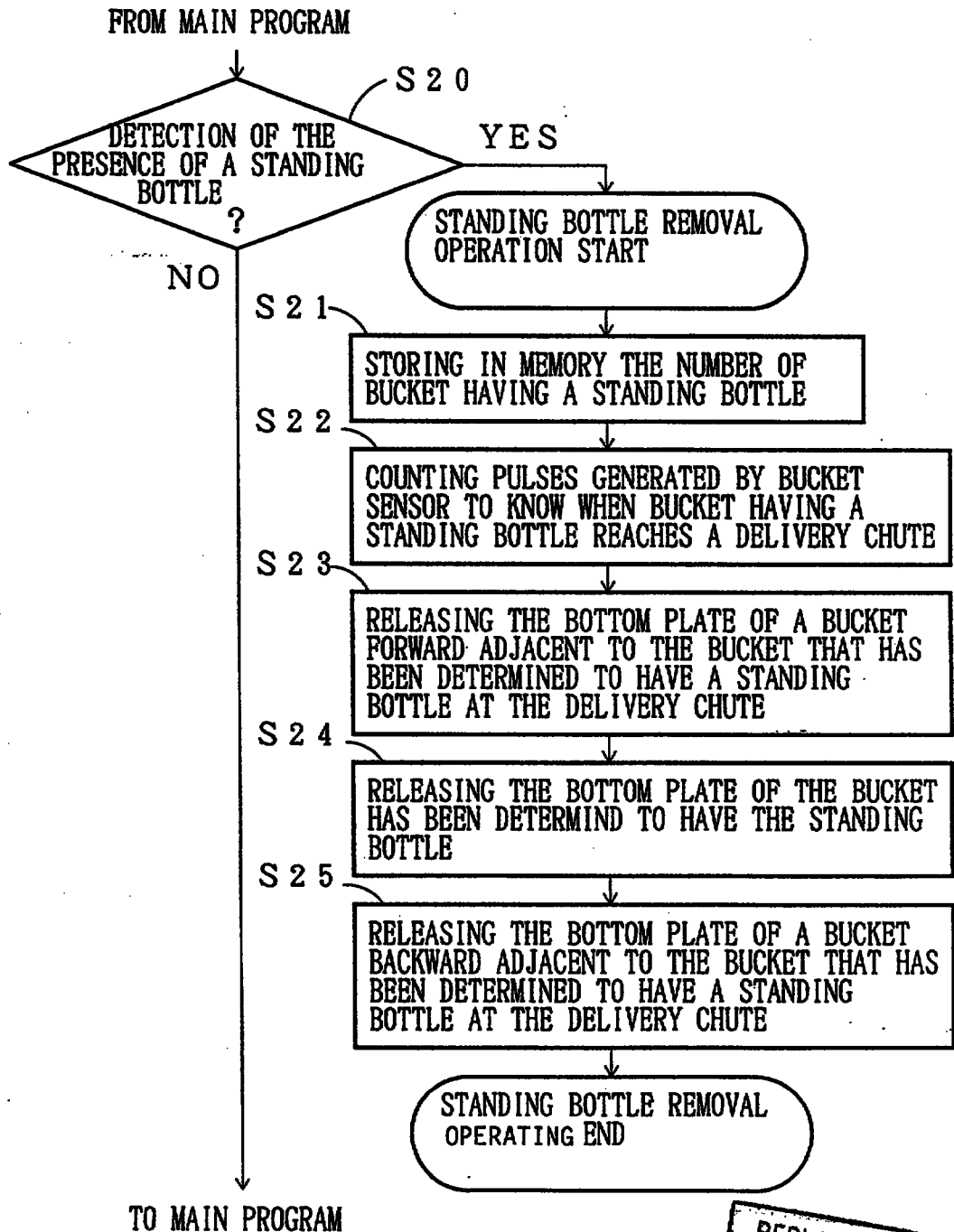


FIG. 12

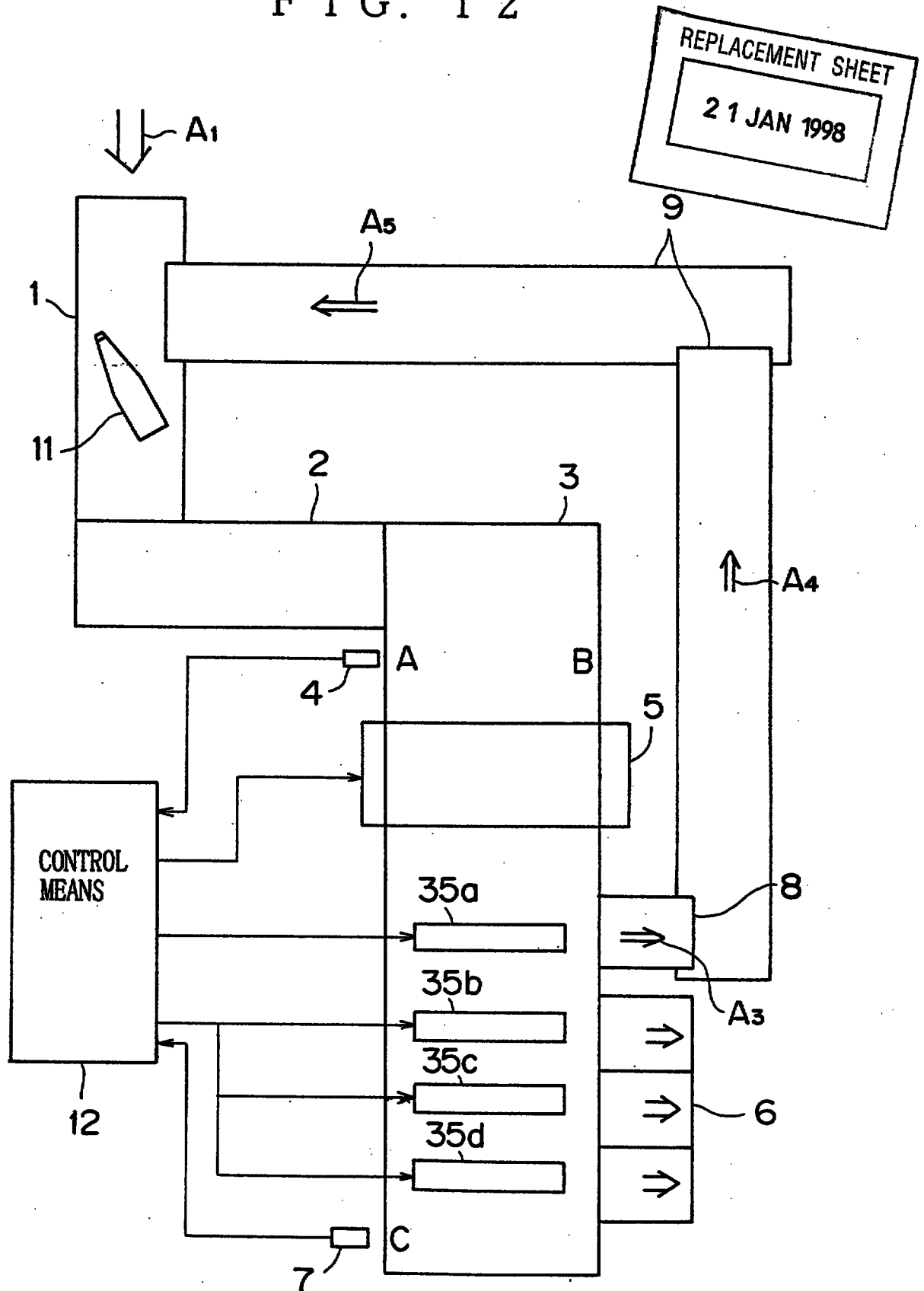
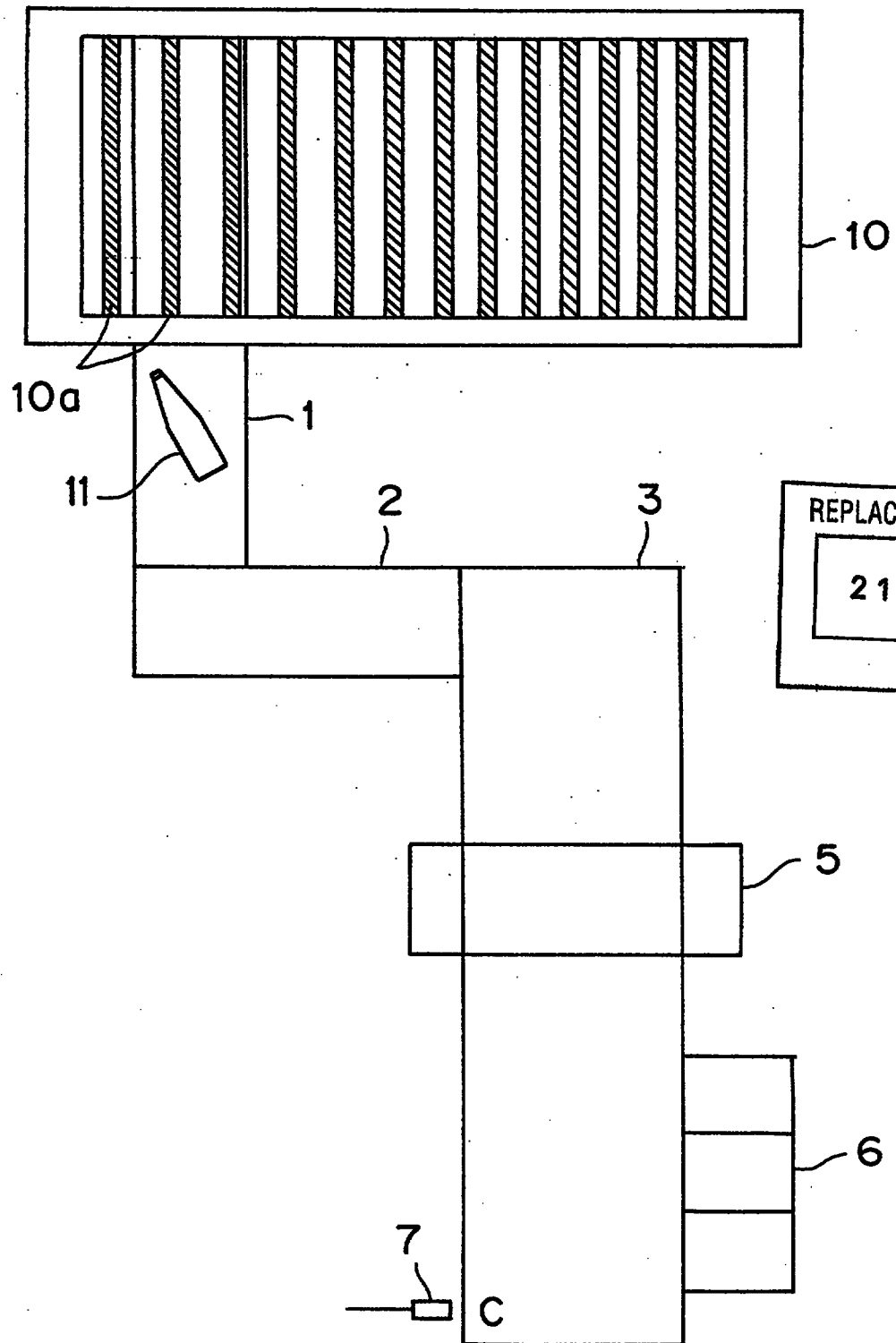


FIG. 13
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REPLACEMENT SHEET

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FIG. 14
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