Oct. 18, 1966 J. G. DRENNAN 3,279,599

BOTTLE SORTING MACHINE AND METHOD

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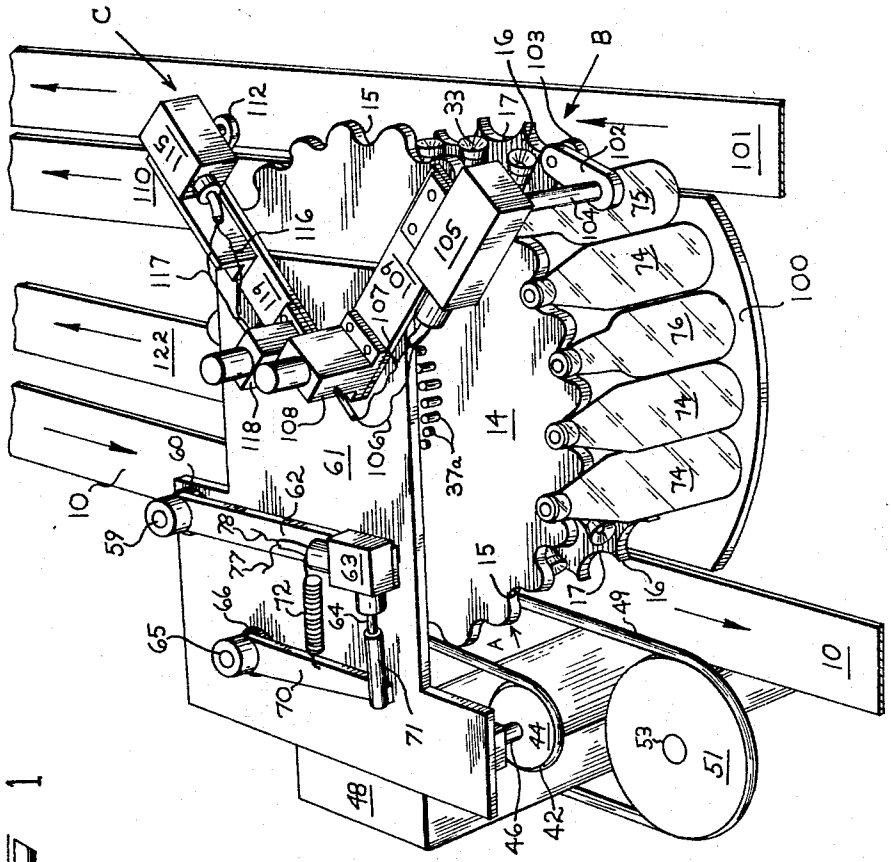


FIG. 1

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JAMES G. DRENNAN

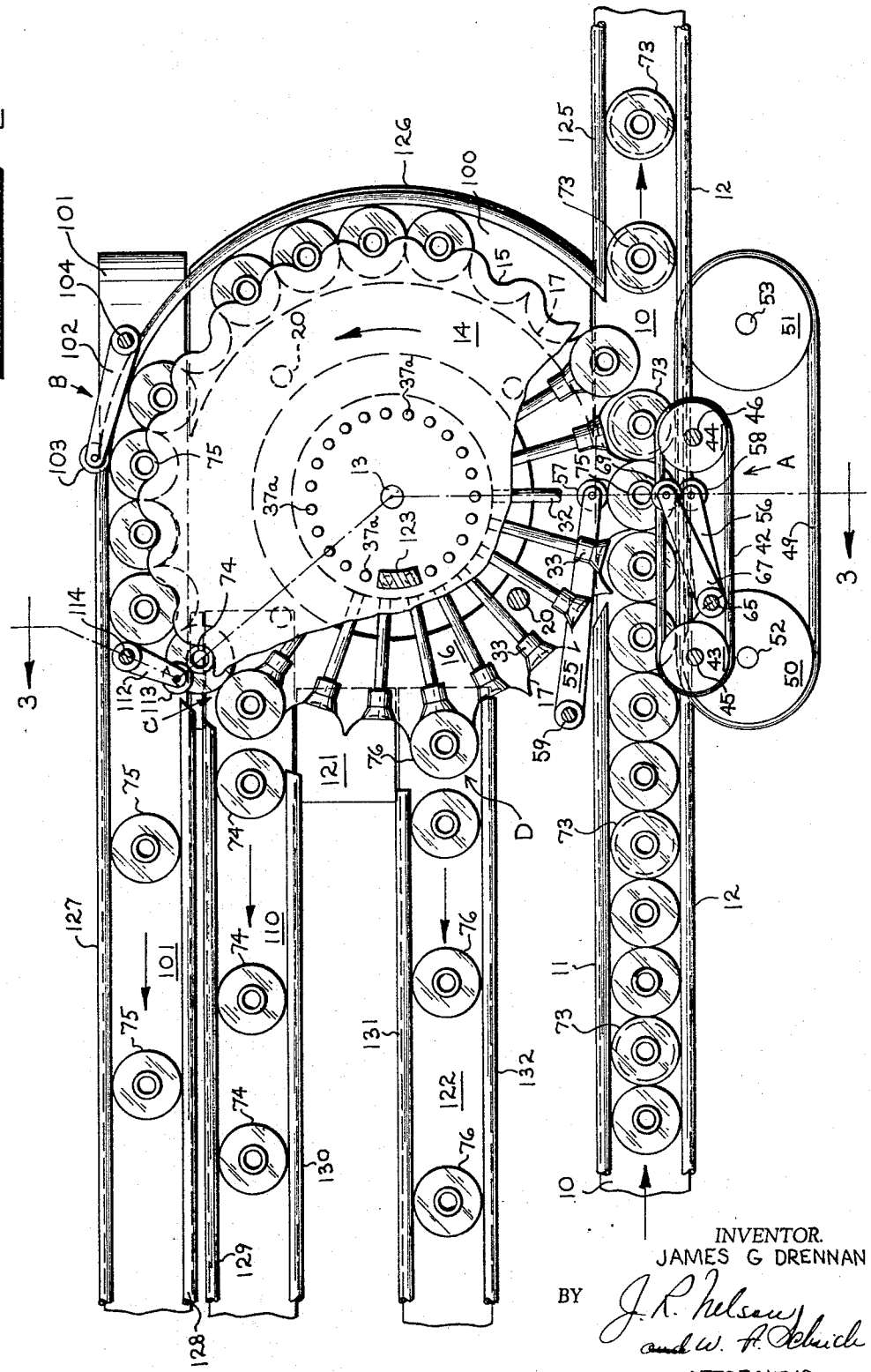
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FIG. 2

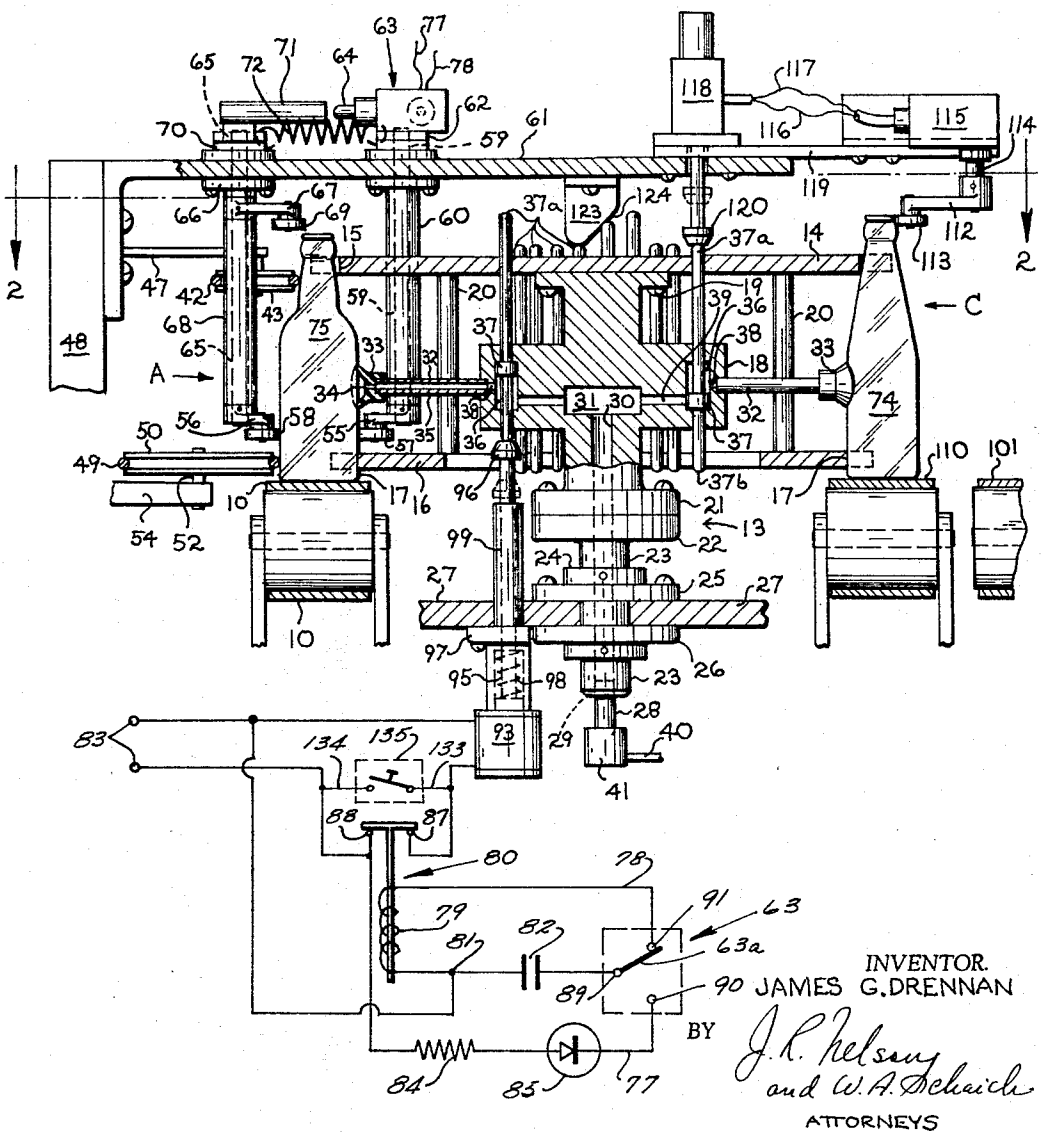


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FIG 3



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FIG. 4

(STATION A)

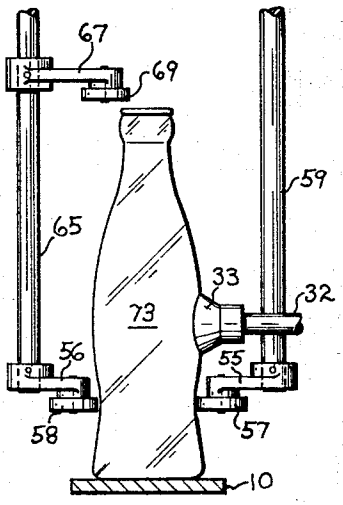


FIG. 5

(STATION A)

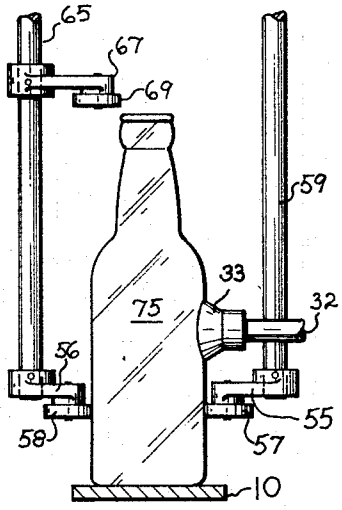


FIG. 6

(STATION A)

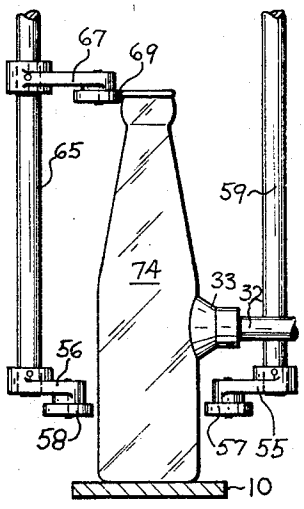


FIG. 7

(STATION B)

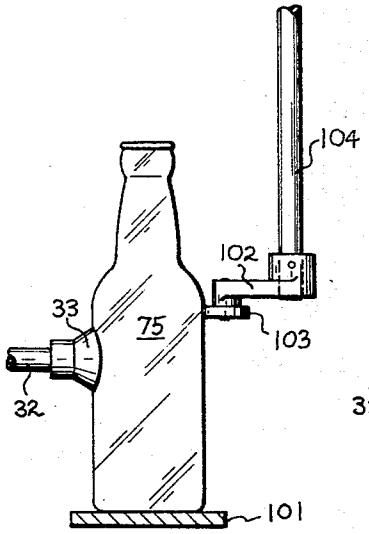


FIG. 8

(STATION C)

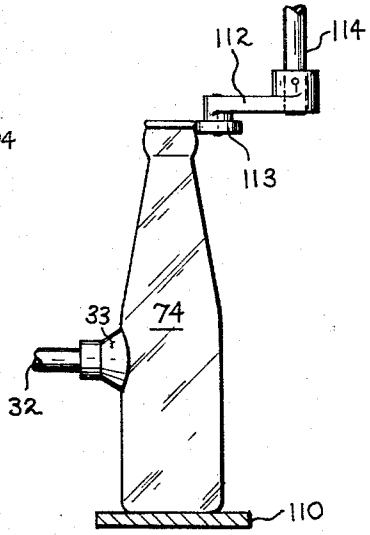
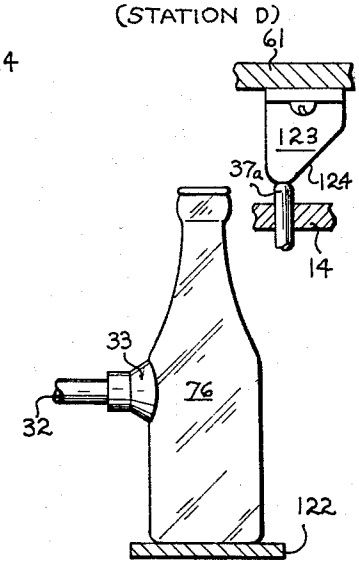


FIG. 9

(STATION D)



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3,279,599

BOTTLE SORTING MACHINE AND METHOD

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Filed Oct. 3, 1963, Ser. No. 313,609
13 Claims. (Cl. 209—74)

The present invention relates to sorting articles by their exterior character, and particularly the invention relates to an improved bottle sorting appartus and method for sorting a random assortment of bottles of two or more kinds or types by virtue of their size, shape, etc., to place all of the bottles of one kind on one conveyor, place all the bottles of a second kind on a second conveyor, and so forth, until the bottles of the random assortment are sorted as desired.

In the bottling plant, for example, where two or more brands of beverage are bottled in returnable bottles, these returnables are received as a mixture and need to be sorted before sending them into the various bottle washing and bottle filling lines. The bottles for these various brands of beverages take on different shapes and exterior configurations so that in nearly every case no two brands of beverage are bottled in the same size or shape bottle. Heretofore, sorting has been done principally manually, or by slow speed apparatus, which makes it cumbersome and costly to supply enough sorted bottles conveniently to the washer-soaker of a given bottling line.

It is therefore contemplated by the present invention to provide a high speed bottle sorting apparatus and method that will conveniently sort bottles by type or kind and supply them to the bottle filling line or elsewhere as needed.

It is also an object of the invention to provide method and apparatus for sorting various kinds of glass bottles in a convenient and economical fashion, yet handle the bottles in a gentle and least damaging manner to avoid breakage and jam-ups in the machine.

Another object of the invention is to provide an improved means and method of the character mentioned which will sort bottles by their height and diameter at an initial station and subsequently carry sorted random bottles to sorting stations whereat the remaining bottles are next selected by a single exterior surface character, such as height, diameter, etc., to form plural sorted lines of bottles for use by the bottler.

In this connection, the present invention provides a valved vacuum system for selective, individual control of application of vacuum to several suction cups arranged radially about a peripherally pocketed starwheel. There is provided herein a series of annularly spaced valves that have valve stems by which the valves are manipulated to either connect or disconnect a vacuum source to the individual cups. An actuator is used to selectively shift those valve spools by which vacuum is to be switched "on" or "off" as the valve moves past the actuator. Devices presently available for engaging and shifting the valve stems while the valves are moving past the device are speed-sensitive; that is, the dwell time of the switching arm for operating the actuator varies with the speed of movement of the bottle in engaging the switch arm, and the valve actuator can be synchronized for only one range of speeds. The present invention provides an electric timer circuit for the actuator solenoid, and this is set to energize the solenoid for a fixed duration independent of speed. More specifically, in this invention, the actuator is operated by a solenoid that is in circuit with a switch means, the latter being controlled in response to a certain characteristic of the bottle presented to the vacuum cup. Since the valve stems of the suction cup valves are carried in a closely spaced annular closed path by the rotation of the pocketed starwheel, and the wheel is to be run at a high rate of bottle handling, such as up to 600–700 bottles per minute, the actuator herein provided is used in connection with this novel control circuit inclusive of the timer to provide a rapid, one-shot operation; and the actuator, such as a reciprocating solenoid-operated plunger, will engage and shift the desired valve stem and retract from possible engagement with other valve stems so as to avoid striking any succeeding valve stem erroneously.

Another object of the invention is to provide a bottle sorting method and apparatus that is capable of selecting bottles from a random assortment of several kinds of bottles and placing them in separate lines. In this regard, the bottles may be selected individually by kind, or by groups which include more than one kind, or sorting may be done by kind and group simultaneously.

Another object of the invention resides in the provision of a bottle sorting method and apparatus that includes a peripherally pocketed wheel with vacuum cups for attaching bottles to the wheel and a multiple memory function by which select bottles may be released at plural stations about the wheel in response to sensed characteristics of the bottles in proximity to these stations, the last station effecting release of all bottles remaining. In this connection, the invention provides a carriage for bottles on the pocketed wheel attached thereon by vacuum so that the wheel provides an accurate and unyielding reference for gauging or sensing the bottle's dimensions or particular exterior surface characteristics for sorting purposes.

A further object of the invention is in the provision of a selecting switch for the valve actuator mentioned which actually calipers a bottle diameter in any predetermined sectional plane of the bottles passing through a sorting station and in so doing discriminates bottles by a diameter change rather than a radius change. This allows sensing twice the difference in change between dimensions of bottles in that plane as compared with sensing a bottle diameter by a single switch lever striking but one side surface of the bottle.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the annexed sheets of drawings, on which, by way of preferred example only, are illustrated embodiments of this invention.

In the drawings:

FIG. 1 is a top perspective view illustrating the principles of my bottle sorting machine and method by which a random assortment of at least four different kinds or shapes of bottles are capable of being sorted into four individual lines.

FIG. 2 is a plan view, partly broken away, taken along line 2—2 on FIG. 3.

FIG. 3 is a sectional elevational view taken along line 2—2 of FIG. 2, and includes a schematic wiring diagram for a specific timer circuit embodiment of the invention for providing rapid operation of the vacuum valve actuator. This view also illustrates a variant of the method and apparatus of the invention by which all bottles brought to the pocketed wheel may be automatically attached to the vacuum cups thereof, and subsequently selectively discharged into sorted groups or lines of bottles on other conveyors.

FIGS. 4–6 are in part spatial schematic elevational views illustrating the principle of the invention, whereby bottles are selected for attachment by the vacuum cups of the pocketed wheel at an inital or first sorting station. More specifically, FIG. 4 illustrates a bottle having both body diameter and height insufficient to actuate the switch rollers shown, and by virtue of this the bottle is not attached by the suction cup to the wheel, this kind of

bottle being thereby sorted to a line on the conveyor which brought it to the wheel. FIG. 5 illustrates a bottle having a body diameter sufficient to engage the switch operating rollers and cause the bottle to be attached to the suction cup of the starwheel by effecting vacuum connection to the cup. FIG. 6 illustrates a bottle having a height sufficient to engage the top or neck roller of the switch and thereby cause the bottle to be attachced to the suction cup of the starwheel by effecting vacuum connection to the cup.

FIG. 7 is an elevational view like FIGS. 4–6, and illustrates a second sorting station in the travel of the starwheel whereat a body diameter sensing switch detects the presence of a second kind of bottle which was attached to the wheel at the first station, this kind of bottle having a distinct shape characterized by a comparatively large diameter at the shoulder. The switch means causes release of the vacuum on the cup of the wheel carrying it to drop off this kind of bottle onto a second conveyor.

FIG. 8 is an elevational view like FIG. 7 and illustrates a third sorting station in the travel of the starwheel whereat a neck or height sensing switch detects the presence of a third kind of a bottle which was attached to the wheel at the first station and passed through the second station, but because of its distinct shape characterized by the height of the bottle, the switch means is engaged to cause release of the vacuum on the cup of the wheel carrying it and deposit this kind of bottle on a third conveyor.

FIG. 9 is an elevational view like FIG. 8 and illustrates a final sorting station in the travel of the starwheel whereat a stationary cam releases the vacuum on any of the cups carrying bottles to that point and these bottles are deposited on a separate conveyor for segregation from the other sorted bottles.

As used in this disclosure, the term "bottle" or "bottles" is intended to encompass glass bottles, jars, or the like and other forms of refillable containers suitable for sorting.

Also, in this disclosure bottles are mentioned as to "kind," "type" or "brand" and these terms are intended herein to distinguish one bottle from another by exterior appearance which shall include some one or more distinctive exterior surface characteristic of a desired bottle to be sorted for the purpose of packaging a commodity therein.

Referring to the drawings, a random assortment or mixture of kinds of bottles to be sorted are advanced forward in single file or seriatim fashion on an infeed or inlet conveyor **10** leading into and through a first station A whereat a certain kind of bottle is to be sorted from the rest in a manner to be presently described. The infeed segment of the conveyor **10** leading to the station A may be provided with suitable parallel side rails or guides **11** and **12** which assures seriatim feeding of the bottles. The guides **11** and **12** are suitably spaced above the surface of conveyor **10** for engaging the sides of the jars and preventing jam-ups. A peripherally pocketed wheel is mounted on vertical shaft assembly **13** for rotation tangentially through the station A on the conveyor **10**. The wheel comprises an upper pocketed starwheel **14** having several bottle receiving pockets **15** about its periphery and a lower pocketed starwheel **16** having a like number of corresponding bottle receiving pockets **17**. The upper wheel **14** is fastened to a hub **18** of the shaft assembly **13** by cap screws **19**. The lower wheel **16** of annular or "doughnut" construction is attached to the upper wheel **14** by plural bolts or rods **20**. The hub **18** of the wheel is attached by its lower flange **21** being bolted to the corresponding flange **22** on the upper end of stub shaft **23** of the assembly **13**. Shaft **23** is retained in a bearing **24** fastened by the upper and lower plates **25** and **26** to a horizontal member **27** of the stationary frame of the machine. The lower end of shaft **23** has an O-ring gland (not shown) which provides a rotatable connection between the stationary lower pipe **28** and the interior bore **29** of the shaft **23**. The hub **18** has an axial central bore **30** that communicates with the passageway of bore **29**, the bore **30** terminating in a cylindrical vacuum chamber **31** defined by the hub **18**.

Attached to the periphery of hub **18** are a plurality of pipes or hollow rods **32** each of which extend radially outwardly and carry a suction cup **33** at their outer end. There is a rod **32** and suction cup **33** for each pocket **15–17** of the wheel and the suction cup is disposed such that it may sealingly engage the side of a bottle brought into its pocket **15–17** on the wheel.

Communicating centrally of each cup **33** is a passage **34** connected with the interior passage **35** of pipe **32**. In the hub **18** opposite the inner end of each pipe **32** is a valve chamber **36** which houses a valve spool **37** that is shiftable axially in chamber **36**. Each spool has a valve stem that has an upper stem **37*a*** which extends through an upper vertical guide bore in the hub, and a lower stem **37*b*** extending vertically downwardly through a lower bore in hub **18**. The upper stem **37*a*** may conveniently have a loose fit with its upper bore in the hub; however, it is preferred the lower stem **37*b*** fit snugly in its lower bore to avoid vacuum leakage and to frictionally retain the valve spool in a set position in opposition to gravity. Each of the upper stems **37*a*** extend through a guide bore in the upper wheel **14** vertically aligned with the axis of the stem. The lower stem **37*b*** depends in the annular space provided by the above-described construction of the lower wheel **16**. The valve chamber **36** is connected at one side by valve port **38** to the passage of the pipe **32**. The opposite side of the chamber and near its lower end is connected to vacuum chamber **31** by internal passage **39** formed radially in the hub **18**. The vacuum is supplied by a source connected at pipe **40** in the lower end coupling **41** on the pipe **28**. This vacuum source is thus applied continuously into the chamber **31** of the hub **18**, and from there is connected to each of the several valve chambers **36** about the hub. When the valve spool **37** is in the "up" position as shown at the left-hand side of FIG. 3, the vacuum is connected to the interior of the suction cup **33**, which attaches the bottle it engages to the starwheel. The manner of manipulating the valves will be presently described. When the valve spool **37** is in the "down" position, as shown at the right-hand side of FIG. 3, the vacuum is disconnected from the suction cup **33** and the latter vented to atmosphere by the loose fit of the upper stem **37*a*** in the hub adjacent the top of valve chamber **36**. Thusly, the suction cup releases its hold on the bottle and the latter is free to leave the starwheel.

Referring again to station A (FIGS. 1–3), an inlet feed means is provided for guiding bottles on conveyor **10** into the sorting position. In the illustrated embodiment of the invention, this inlet feed means comprises an upper belt **42** running on spaced apart pulleys **43** and **44** which are respectively freely rotatably mounted on vertical shafts **45** and **46**. These shafts **45** and **46** are mounted to depend from horizontal brackets **47** (one of which is shown on FIG. 3) attached to the vertical frame member **48**. The belt is thus mounted to run parallel to the conveyor **10** and extends through the station A to guide the upper portion, such as the neck portion, of the bottles into engagement with a pocket **15** on the upper pocketed wheel **14**. The inlet feed means also includes a lower belt **49** running on its spaced apart pulleys **50** and **51**, respectively freely rotatably mounted on vertical shafts **52** and **53** which are mounted on horizontal brackets **54** (one being shown on FIG. 3) to be attached to the vertical frame member **48**. The belt **49** runs parallel to the conveyor **10** and extends through the station A to guide the lower body portion of the bottles into engagement with a pocket **17** of the lower pocketed wheel **16**. This also places each of the bottles passing through station A in engagement with the suction cup **33** of one of the pockets. The belts **42** and **49** are preferably yieldable for guiding

various diameter bottles into place on the pocketed wheel, and thus are constructed of endless coil springs.

The inlet feed means also serves a second function, as will be apparent from the following description of the novel bottle detecting unit. At station A are a pair of opposed rock arms **55** and **56** each having a free end engageable with a bottle as it is guided in the station A by the belts **42, 49**. The ends of rock arms **55** and **56** may be provided with rollers, respectively numbered **57** and **58**, for contacting the bottles. The rock arm **55** is pinned on a vertical shaft **59** journaled in a tubular bearing mounting **60** that is attached to the underside of horizontal plate **61**. This plate **61** is cantilever mounted on vertical frame members **48** to overhang the wheel structure and provide a super structure for mounting various pieces of the equipment to be attached in stationary positions on the machine. Keyed on the upper end of shaft **59** is a switch lever **62** that extends horizontally in the same respect as rock arm **55**, and pivotal movement of rock arm **55** will impart a corresponding pivotal movement of lever **62**. On the outer end of lever **62** is a microswitch **63** which has a laterally extending contactor **64**. Switch **63** is a double throw, single pole switch, an example of which is the "Micro," Model No. BZE–2RN, manufactured and sold by the Micro Switch Company and described in their bulletin No. 81, published June 1, 1950. Switch **63** when operated by a bottle causes the solenoid relay **80** to fire, as will be presently described.

The rock arm **56** is pinned on a vertical shaft **65** journal mounted in a bearing **66** attached to the underside of plate **61**. Immediately below the bearing is a single rock arm **67** pinned on shaft **65** and immediately below it is a tubular bushing **68** extending down to the rock arm **56**. The arm **67** may be provided with a bottle contacting roller **69**. Keyed on shaft **65** above the bearing **66** is a second switch lever **70** which extends horizontally in the general direction of switch lever **62**. The outer end of lever **70** is provided with a lug **71** aligned to engage the contactor **64** of switch **63**. The levers **62** and **70** are connected by a coil spring **72** which normally maintains lug **71** and contactor **64** of the switch engaged. This bias of the spring **72** maintains switch bar **63***a* set to connect terminal **89** and contact **90** and the lug **71** and contactor **64** cooperate in the engaged position, as shown on FIG. 1, to set the ends (rollers) of the rock arms **55** and **56** (FIGS. 2 and 3) in predetermined spaced relationship for gauging certain body diameters of bottles at the elevation of their mounting. In setting up the machine, for example, the elevation or horizontal plane for movement of the arms **55, 56** is selected as shown on FIG. 4 for a diameter of the body of a given bottle, as bottle **73**, desired to be sorted at station A and left on conveyor **10**. This selected diameter on bottle **73** is one of the smaller diameters at this plane or elevation of all the bottles in the assortment of various kinds of bottles to be handled. Thus, as the bottles of one kind or another pass into station A and between the rollers of the spaced arms **55, 56**, the arms will remain stationary and switch **63** will be maintained set to connect the circuit for charging condenser **82**.

The upper rocker arm **67** is set at a selected elevation and adapted for movement in a determined horizontal plane that is to be above or clear of the top rim of the bottle **73** desired to be sorted at the first station. Thus, the kind of bottle sorted at station A is to be one of lesser height than some of the other kinds, such as bottle **74**, FIGS. 6 and 8, and of the shorter bottles, which includes, for example, bottles **75** (FIGS. 5 and 7) and **76** (FIG. 9) which have a lesser diameter at the elevation selected for mounting the rollers of the rock arms **55, 56**.

At this point it should be mentioned that the drawings herein illustrate all the gauging and sensing mechanisms as mounted in fixed positions. This is done for ease of illustration of the principle of the invention in giving one set-up as an example for bottle sorting. It should be obvious to those skilled in the art that these assemblies be mounted for vertical adjustment by any one of several suitable adjustable mountings such that in changing job set-ups the various switch operating arms may be raised or lowered as desired. This feature, although not illustrated herein, is contemplated in the scope of the invention.

Referring to FIG. 3, switch **63** has leads **77** and **78** on opposite terminals of the switch blade. Lead **78** is in circuit with the coil **79** of a normally open relay **80**, and the coil is in turn connected at a juncture **81** at one side of A.C. line source **83**. The condenser **82** is connected between switch terminal **89** and coil **79**. Switch **63** is normally set to connect **89** and **90** so that the condenser **82** is connected to a D.C. power source for charging the condenser. The charging circuit includes a connection to the other line of A.C. line source **83**, a resistor **84** and a silicon diode **85** (rectifiers). When switch **63** is operated to connect **89** with contact **91** the relay coil **79** is energized by discharge of condenser **82**. The condenser **82** may vary in size with the speed required in operating the plunger **96** and solenoid **93** and the length of dwell at the end of each stroke. As an example, a 10-microfarad condenser was used in operating at handling speeds of 600 pieces per minute. Condenser **82** is rapidly discharged when limit switch **63** is operated by a bottle at station A and set as shown on FIG. 3. The condenser is thusly connected across coil **79**. Additional resistance may be placed in circuit with the coil if needed to regulate the reaction of the timer system. This provides a time-responsive means for operating relay **80** which in turn has its relay contacts **87** and **88** in a power circuit closable by the contact bar of the relay **80**. The solenoid **93** is connected to the plunger rod **95** of the valve spool actuator **96** and the assembly is attached to the underside of the frame member **27** by bracket **97**. The plunger rod and plunger **95–96** is normally in a retracted inactive position (shown in dotted outline) by the coil spring **98** biasing the solenoid. The plunger rod is guided by the tubular bushing **99** secured in vertical position on frame **27**.

As above described, the valve spools **37** are normally set in position at station A, by means to be later described, so that the suction cups **33** are disconnected from the vacuum source in hub chamber **31**. In operation, the above-described mechanism may be used to sort one kind of bottles, such as represented by bottle **73** on FIG. 4, from the other kinds of bottles represented by **74–76** on the drawings, in the following manner. As bottle **73** is presented to the initial sorting station A, suction cups **33** are connected to atmosphere. By virtue of its mentioned predetermined exterior surface characteristics, i.e. its size and shape, bottle **73** will fail to operate either of the rock arms **55, 56** or **67**. Switch **63** will thus remain open, relay **80** will be normally open and solenoid **93** de-energized so that the plunger valve actuator **96** will be retracted. The vacuum will therefore not be connected to the suction cup **33** and bottle **73** will index through a pocket of the wheel at sorting station A and move linearly with conveyor **10**. As succeeding bottles pass into station A and a bottle **75** (FIG. 5) is present, the body diameter of it exceeds the predetermined bottle diameter spacing for rock arms **55, 56** and, although bottle **75** is too short to engage the top rock arm **67**, the arms **55, 56** will be pivoted away from each other by this kind of bottle. This movement will cause switch levers **62, 70** to also rotate away from each other with the result the limit switch **63** will be operated (as shown in the lower diagram, FIG. 3). This causes the microswitch to connect the circuit through **89, 91** momentarily while the bottle **75** is spreading the arms **55, 56** and levers **62, 70** discharging condenser **82** through coil **79** of the relay which will, in turn, energize the solenoid for a rapid, one-shot extension of plunger actuator **96**. The actuator will

engage the lower valve stem **37***b* of the appropriate valve and connect vacuum to the suction cup **33** engaging the side of the bottle **75**. This attaches this certain bottle type to the wheel and as it rotates the bottle **75** is carried in a different direction from conveyor **10**. As seen on FIG. 1, the bottles on the wheel slide over an arcuate deadplate **100** toward a second conveyor **101**. This conveyor **101** is shown running in the opposite direction from conveyor **10**, but it could run in practically any direction out from the wheel. Over conveyor **101** there is a second sorting station indicated by "B." A bottle gauging and sensing unit is provided at this station, as may be seen on FIGS. 1, 2 and 7. A rock arm **102** having an outer end roller **103** thereon is rotatably mounted by a vertical shaft **104**. The shaft is a part of microswitch unit **105**, which may be of the type mentioned in describing the switch **63**. The leads **106** and **107**, shown schematically on FIG. 1, are in the circuit of the solenoid of the solenoid-operated plunger unit **108**. The microswitch **105** and plunger unit **108** are each mounted on a plate **109** fastened to the member **61** of the frame. The switch **105** is thus mounted at station B in such a position that only a selected larger diameter of a bottle **75** will engage and rock the arm **102**, thereby closing the microswitch and firing the solenoid of plunger unit **108**. The plunger of unit **108** is similar to the previously described solenoid-operated plunger device **93**, **95**, **96**, etc., and is aligned with the closed path of the several valve stem tips **37***a* and in a place to extend and engage the stem **37***a* that corresponds with the suction cup **33** holding bottle **75** that actuated or tripped microswitch **105**. As the overhead plunger (not shown) of the unit **108** is rapidly lowered, it strikes this one valve stem and shifts the valve spool **37** thereof downwardly, such as shown at the right side on FIG. 3, disconnecting the vacuum source to its corresponding suction cup **33**, thereby releasing bottle **75** to conveyor **101**. At this point two kinds of bottles are sorted.

Advanced in the travel of the wheel is a third sorting station, herein identified as "C." This is best understood with reference to FIGS. 1–3 and 8. Any bottles remaining attached to the pocketed wheel, such as bottles **74** and **76**, are carried across conveyor **101** toward a third conveyor **110**. Station C overlies this conveyor and a bottle gauging and sensing unit is mounted thereat. This unit comprises a rock arm **112** and end roller **113** attached on vertical shaft **114** which is rotatably mounted on the microswitch **115**. This switch may be one similar to switch **63** with the leads **116** and **117** connected to the solenoid of the solenoid-operated plunger unit **118**. The switch **115** is closable by rocking motion of the arm **112**. The switch and rock arm are mounted on a lateral bracket **119** extending outwardly from the frame plate **61** and the mounting places the rock arm at an elevation to contact the top portion of the tall bottles, such as the type of bottle **74**.

The plunger unit **118** is mounted at station C such that its plunger **120** is aligned with the closed path of the several upper valve stems **37***a* and at a position to move downwardly from its normally retracted position (dotted outline, FIG. 3) and strike the valve stem **37***a* that corresponds with the valve and suction cup **33** holding the bottle **74** engaging the rock arm **112** of the switch. Thusly, the tall bottles, as **74**, trigger the solenoid and plunger **120** shifts the proper valve spool **37** to disconnect the vacuum to its suction cup **33**, thereby releasing bottles **74** to conveyor **110**. Up to here, three kinds of bottles are sorted.

A fourth kind of bottle **76** or a group of bottles of different kinds represented by **76** may be sorted at a fourth sorting station "D." As the bottles **76** attached to the pocketed wheel are carried beyond conveyor **110**, they pass over a deadplate **121** toward a fourth conveyor **122** moving in the direction shown on FIG. 2. At this station there is provided a means operated by the travel of the wheel through the fourth station for automatically releasing the vacuum from any of the remaining cups on which vacuum is still applied, thereby releasing the bottles from these cups **33**. By the illustrated preferred form, this means comprises a downwardly depending cam member **123** that has a sloped face **124**. The cam **123** is bolted to the underside of frame plate **61** in a position so that its sloped face **124** is in the closed path of the upper valve stems **37***a* and the cam face **124** will engage any of the upwardly extending valve stems **37***a* as they reach a point opposite the sorting station D. Such engagement will move the valve spool **37** of that valve downwardly to a position such as shown on FIG. 3, right-hand valve **37**, and thereby release the vacuum from the **33**.

At this point, all bottles are unloaded from the pocketed wheel ready for the pockets **15**, **17** and cups **33** to successively thereafter move into station A, whereat their sorting cycle is able to be repeated.

As shown on FIG. 2, the conveyors may be provided with guide rails, as follows. The outlet segment of conveyor **10** has the extended guide rail **12** spaced above it and along one side and opposite this guide rail is a second generally parallel guide rail **125**. The spacing between **12–125** is approximately one bottle diameter to prevent jam-ups and keep the outgoing bottles in single line. About the periphery of the pocketed wheel along deadplate **100** is an arcuate guide rail **126**. This guide rail merges at one end with the beginning of guide rail **125** and the other end connects with a guide rail **127** extending along the outer side of conveyor **101**. Opposite rail **127** is a parallel guide rail **128**. Conveyor **110** is shown as equipped with parallel guide rails **129** and **130**, and conveyor **122** has the parallel guide rails **131** and **132**.

A second variant of the invention is illustrated on FIG. 3, which demonstrates the flexibility of the method and machine of the invention. A means is provided at the first station A to normally set all the valves of the suction cups to connect them to vacuum, comprising a shunt circuit having leads **133** and **134** across the contacts **87** and **88** of the relay **80** and a manually-operated, single pole, single throw switch **135** in the circuit with the leads **133** and **134**. By closing the switch **135**, the solenoid **93** will be continuously energized holding valve actuator **96** in its "up" position continuously. In such position, the member **96** will automatically engage each of the lower valve stems **37***b* in succession such as a cam as they move in their closed path on the wheel into station A, thereby shifting the valves **37** to connect the suction cups **33** to the vacuum by the time of their arrival at the first station A. All of the bottles will be attached to the vacuum starwheel unit and they are thereafter sorted at the subsequent stations B, C and D, as described above.

It should be understood that the above described embodiment is given as an example of the method and apparatus of the invention and is in no way intended to be limiting to the scope of the features and principles of the hereinafter claimed invention. For example, additional switches and conveyors making up further sorting stations may be added about the periphery of the wheel. The conveyors outgoing from the various sorting stations can be arranged in a convenient manner to carry the sorted bottles in any direction from the wheel and to any desired location and use. As long as a kind of bottle to be sorted differs from the other bottles in the assortment supplied, such bottles may be sorted (by kind) using the principles taught herein of this invention.

While embodiments of the present invention have been herein specifically described, other embodiments and variations may occur to those skilled in the art after a knowledge of the disclosure herein, and it is desired to include within the scope of the patent granted hereon

all such embodiments and variations, and more particularly as comprehended by the appended claims.

I claim:

1. A bottle handling apparatus comprising a bottle engaging starwheel pivotally mounted on a vertical shaft, comprising an upper pocketed wheel on said shaft, a lower pocketed wheel on said shaft, both said wheels having corresponding bottle receiving pockets, and a hub on said shaft defining a vacuum chamber, a horizontal inlet conveyor advancing bottles in seriatim fashion in tangential relation to said starwheel and successively into said pockets, vacuum applying means connected to said chamber, a plurality of bottle engaging cups, means mounting said cups individual to said bottle receiving pockets for engaging a bottle therein, said means including conduits for applying vacuum to each of said cups, individual spool valves on said starwheel in each said conduit and having a spool operable for alternatively connecting the cup to atmosphere and to said vacuum chamber, a valve operator connected to each said valve spool, a solenoid-operated actuator mounted along the path of movement of said valve operators, a first limit switch in the circuit of said solenoid operated by bottles on the inlet conveyor of predetermined dimension to energize the solenoid and shift said valve spool to apply vacuum to the cup engaged with the corresponding bottle, thereby transferring said bottle from said inlet conveyor, a second conveyor tangent with the starwheel spaced peripherally thereof from the inlet conveyor, a second solenoid operated actuator in the path of the valve operators along said second conveyor, a second limit switch in circuit with the second solenoid and mounted in a predetermined horizontal plane of bottles carried by the starwheel, this limit switch being operated by a bottle having a predetermined dimension in that plane, said second limit switch energizing its solenoid and operating the valve spool to disconnect the vacuum to the cup carrying such a bottle, thereby releasing said bottle to said second conveyor, and means for subsequently operating any of the valve spools not operated at said second conveyor at a point of travel beyond said second conveyor thereby releasing bottles from the starwheel being carried beyond said second conveyor.

2. A bottle sorting apparatus comprising a peripherally pocketed wheel mounted for rotation about a vertical axis, radial outwardly opening suction cups individual to the pockets, a first conveyor for bringing bottles in seriatim fashion into engagement with the cups, a source of vacuum, means individual to the cups including a valve operable for connecting or disconnecting them to said source of vacuum, valve operating means operable by bottles of predetermined dimension being brought into engagement with the cups to connect the cup to vacuum, said bottles being removed from the first conveyor thereby for travel with the wheel, a second conveyor spaced peripherally about the wheel from said first conveyor, a second valve operating means located in the path of the bottles on the wheel being carried to said second conveyor, the second said means being operable by bottles having a predetermined dimension at a preselected horizontal plane to disconnect the cup to vacuum and thereby effect the release of such bottles to the second conveyor, and third valve operating means located beyond said second conveyor to effect setting all valves to disconnect their cup to vacuum, thereby effecting release of any bottles carried beyond the second conveyor.

3. A bottle sorting apparatus comprising a peripherally pocketed wheel mounted for free rotation about a vertical axis, radial outwardly opening suction cups individual to the pockets, a first conveyor for bringing a random assortment of bottles to be sorted in seriatim fashion into successive engagement with the wheel and cups thereon and rotating the wheel, a source of vacuum, a first sorting station on the first conveyor, means at said station operated in response to the presence of bottles of predetermined shape and size for applying the vacuum to certain of the cups engaging said bottles thereat and cause said certain cups to hold said bottles for travel with the wheel, a second conveyor spaced peripherally about the wheel from the first conveyor, a second sorting station on the second conveyor, means at said second station operated in response to the presence of a predetermined distinctive exterior surface characteristic of said bottles for releasing the vacuum from the cups engaged with those bottles to release them to said second conveyor, and means operated during travel of the cups of said wheel beyond said second station for releasing the vacuum from any of the remaining cups on which vacuum is yet applied, thereby releasing the bottles from said cups traveling beyond said second station.

4. A bottle sorting apparatus comprising a peripherally pocketed wheel mounted for rotation about a vertical axis, radial outwardly opening suction cups individual to the pockets, a first conveyor for bringing a random assortment of bottles to be sorted in seriatim fashion into successive engagement with the pocketed wheel and cups thereof as the wheel rotates, a source of vacuum, means operated in response to the presence of bottles for applying the vacuum to the cups engaging the bottles, thereby attaching bottles to the wheel, second conveyor spaced peripherally about said wheel from the first conveyor, a sorting station over the second conveyor, means at said station operated in response to the presence of a single predetermined distinctive exterior surface characteristic of certain bottles carried by the wheel for releasing the vacuum from the cups engaged with those bottles and release them to said second conveyor, and means operated in the travel of the wheel beyond said station for releasing the vacuum from any of the remaining cups on which vacuum is applied, thereby releasing the bottles from said cups.

5. A bottle sorting method comprising moving a series of outwardly opening suction supplying devices in an annular endless path past a conveyor, moving a random assortment of several types of bottles to be sorted in seriatim fashion on the conveyor into engagement with the moving suction applying devices at a first sorting station on the conveyor, detecting the presence of certain of the bottles at said first station which poses predetermined characteristics by which said certain bottles are to be sorted, applying vacuum to the said devices corresponding with said certain bottles, thereby attaching such bottles for movement with said devices, moving said certain bottles to a second sorting station on a second conveyor spaced from the first conveyor, detecting the presence of one particular bottle type at said second station by the presence of a predetermined distinctive exterior surface characteristic thereof, releasing the vacuum from each said suction device engaging a bottle of said particular type, thereby releasing each of such bottles to said second conveyor for segregated movement with the latter, and subsequently releasing the vacuum from all the other said suction devices moving bottles beyond said second station.

6. A method of sorting bottles by type comprising bringing in seriatim fashion a random assortment of bottles to a sorting station, selecting all of the bottles of one type by a predetermined maximum diameter at a selected longitudinal section thereof and by a predetermined maximum height and moving them in seriatim fashion away from the sorting station, grasping all of the bottles having a diameter at said section in excess of the predetermined maximum diameter or height in excess of said maximum height, moving the grasped bottles away from the sorting station to a spaced second sorting station, selecting the grasped bottles having a predetermined maximum physical dimension characteristic of a second type of bottle of said assortment of bottles, releasing the selected bottles of said second type thereof from their suction devices, moving any of the remaining grasped bottles to a spaced third sorting station, selecting the grasped bottles at said third

station having a predetermined maximum physical dimension characteristic of a third type of bottles of said assortment of bottles, releasing any selected bottles of said third type thereof from their suction devices, moving any remaining grasped bottles away from said third sorting station and thereafter releasing them from their suction devices.

7. A bottle sorting apparatus comprising a peripherally pocketed wheel mounted for rotation about a vertical axis, radially outwardly opening suction cups individual to the pockets, a first conveyor for bringing a random assortment of bottles to be sorted in seriatim fashion into successive engagement with the pocketed wheel and cups thereof as the wheel rotates, a source of vacuum, means individually connecting each of the cups to the vacuum source and including a valve operable for connecting or disconnecting each cup to said source, each valve having a vertically shiftable valve spool and outwardly extending stems at opposite axial ends of said spool, guide means engaging the bottles on the conveyor and bringing them in succession into engagement with the pockets and cups on the wheel at a first station, means adapted to engage the valve stems and normally set the valves to connect the cups to said vacuum source at the first station, thereby attaching the bottles to the wheel, a second conveyor spaced peripherally about the wheel from the first conveyor, a sorting station over the second conveyor, means at said station operated in response to the presence of a single predetermined distinctive exterior surface characteristic of certain of the bottles carried by the wheel for engaging the valve stem for the cup carrying such bottle and disconnecting the vacuum to the cup to release such bottle to the second conveyor, and means peripherally spaced beyond said second station and ahead of said first station adapted to engage the valve stems of any of the cups connected to vacuum and shift their valves to disconnect the vacuum, thereby releasing the bottles from such cups.

8. A bottle sorting apparatus comprising a peripherally pocketed wheel mounted for rotation about a vertical axis, radial outwardly opening suction cups individual to the pockets, a conveyor for bringing a random assortment of bottles to be sorted in seriatim fashion into successive engagement with the wheel and cups thereon, a sorting station on the conveyor, the wheel rotating past said sorting station, a pair of rock arms pivotally mounted in the path of said bottles at said station for movement in a horizontal plane, means connecting said arms and normally maintaining them in a predetermined spaced relation in said plane, an inlet feed means for guiding the bottles on the conveyor into the sorting station in engagement with the pockets of the wheel and between said spaced rock arms, comprising a pair of belts, two sets of pulleys mounted for free rotation in guiding the belts parallel to the conveyor and through the sorting station, the belts being spaced from the periphery of the pocketed wheel at the inspecting station to guide the bottles on the conveyor into engagement with a pocket of the wheel, a source of vacuum, means operable for applying vacuum to the cups including a valve individual to each of the cups, a solenoid valve operator adapted to connect vacuum to certain of the cups at the sorting station, a switch in circuit with said solenoid for energizing said valve operator, a switch operating device connected to said arms for energizing the solenoid upon movement of the rock arms, and means operated in the travel of the cups of said wheel beyond the sorting station for setting the valves to release vacuum from the cups carrying bottles, whereby certain bottles being carried beyond said station are sorted from others permitted to travel on the conveyor past said station.

9. The bottle sorting apparatus defined in claim 8, wherein the belts comprise endless coil springs yieldable by engagement with the bottles.

10. A method of sorting bottles by type, comprising bringing in seriatim fashion a random assortment of bottles to a sorting station, sensing the bottles at the sorting station to detect those having a predetermined unique charactertistic of one type of bottle to be sorted, selecting all of the bottles of the one said type of bottles at the sorting station, moving said selected bottles of one type in seriatim fashion in one direction away from the sorting station, grasping all of the bottles of the other types thereof by a suction device at the sorting station, and moving these suction devices and bottles held thereby away from the sorting station in a different direction than said one direction, thereby sorting the bottles of said one type from the bottles of the other of said types of bottles, bringing the bottles on said suction devices in seriatim fashion to a second sorting station spaced in said different direction from the first-mentioned sorting station, sensing bottles of a second type at said second station to detect a predetermined unique characteristic of a second type of bottle to be sorted, releasing the suction devices from the sensed bottles of said second type at said second station, and moving these released bottles in seriatim fashion away from the second sorting station.

11. The method of sorting bottles defined by claim 10, wherein bottles moved by the suction devices of the third type thereof are brought by the suction devices to a third sorting station remote from said second sorting station and spaced from the sorted second type of bottles, whereat said bottles are selected and released by their suction devices for movement in seriatim fashion away from the third sorting station, and releasing any remaining bottles held by suction devices subsequent to separating movement thereby away from the third sorting station and the bottles released at said third station.

12. A bottle handling apparatus comprising a bottle engaging starwheel pivotally mounted on a vertical shaft and defining bottle receiving pockets, and a hub on said shaft defining a vacuum chamber, a horizontal inlet conveyor advancing bottles in seriatim fashion in tangential relation to said starwheel and successively into said pockets, vacuum applying means connected to said chamber, a plurality of bottle engaging cups, means mounting said cups individual to said bottle receiving pockets for engaging a bottle therein, said means including conduits for applying vacuum to each of said cups, individual valve means in each said conduit and operable for alternatively connecting the cup to atmosphere and to said vacuum chamber, a valve operator connected to each said valve means, a solenoid-operated actuator mounted along the path of movement of said valve operators, a first sensing means connected to said solenoid and operable by bottles on the inlet conveyor having a predetermined physical characteristic to energize the solenoid and actuate said valve means to apply vacuum to the cup engaged with the corresponding bottle, a second conveyor tangent with the starwheel spaced peripherally thereof from the inlet conveyor, a second solenoid operated actuator, a second sensing means connected to the second solenoid operated by a bottle carried on the starwheel and having a predetermined distinct physical characteristic for sensing by said second sensing means thereby energizing said second solenoid and actuating the valve means to disconnect the vacuum to the cup carrying such a bottle, thereby releasing said bottle to said second conveyor, and means for subsequently operating the valve means at a point of travel beyond said second conveyor thereby releasing the vacuum to the cups having bottles thereon beyond said second conveyor.

13. An article sorting apparatus comprising means for carrying a series of suction cups in motion along a closed path passing through a first and a plurality of subsequent stations, a first conveyor means for carrying articles sequentially along a path bringing the articles into engagement with said suction cups at said first station, a

vacuum source, means for selectively connecting said vacuum source to said suction cups passing through said first station and maintaining the vacuum of article engaging suction cups moving along said closed path beyond said first station, a plurality of other conveyor means each passing through said one of the other of said subsequent plural stations, means for releasing the vacuum of selected cups passing through said other stations to release the article onto said other conveyor means, and means operable at a point along said closed path between said other stations and said first station to release the vacuum of article engaging suction cups passing said point.

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