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Weber

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[54] **BOTTLE SORTING APPARATUS**

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[52] **U.S. Cl.** **73/45.2**

[51] **Int. Cl.** **G01m 3/32**

[58] **Field of Search** 73/37, 40–45.4, 73/49.8; 141/97

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[57] **ABSTRACT**

Bottles fed to a rotating carrier are sequentially tested for resistance to compressive stress, for resistance to internal gas pressure, and for leak proofness, and failing bottles or their broken pieces are deflected from the carrier, and the other bottles are separately discharged. A sealing head moving with the carrier along a cam track is lowered on each tested bottle and a piston in the head is pressed axially against the bottle neck under gas pressure supplied from a distributor valve for compression testing until a shut-off valve attached to the piston is opened by the resistance of the bottle, whereby the bottle is relieved of compressive stress and subjected to internal gas pressure. The latter is raised stepwise and then released, and the gas is largely recovered. Leak proofness is tested by sensing retention of gas pressure in the sealed, tested bottle or by sensing the direction of gas flow from the tested bottle toward an area of lower gas pressure.

8 Claims, 7 Drawing Figures

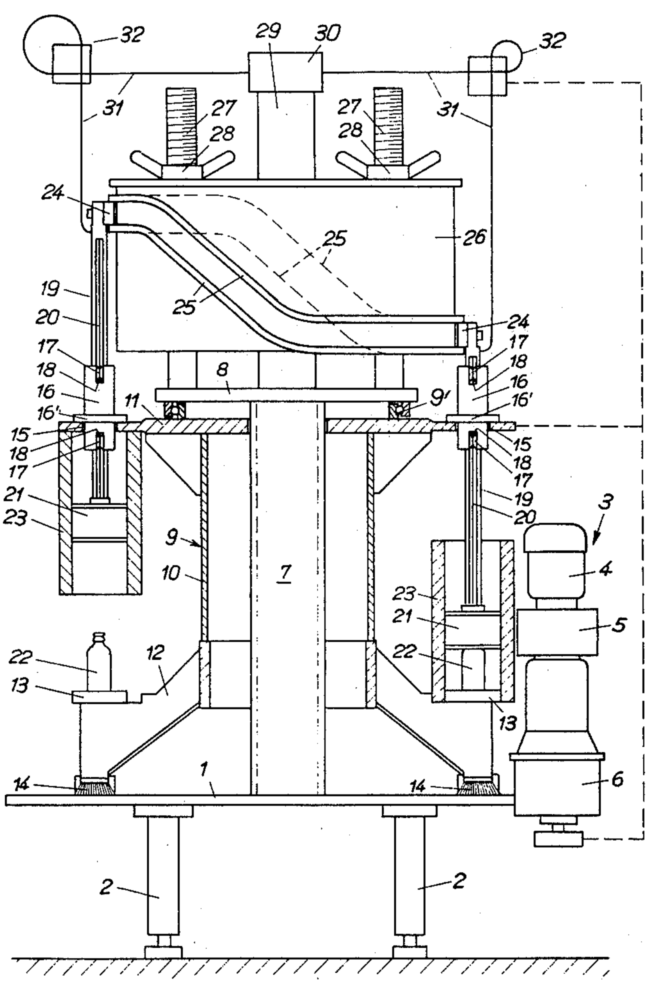
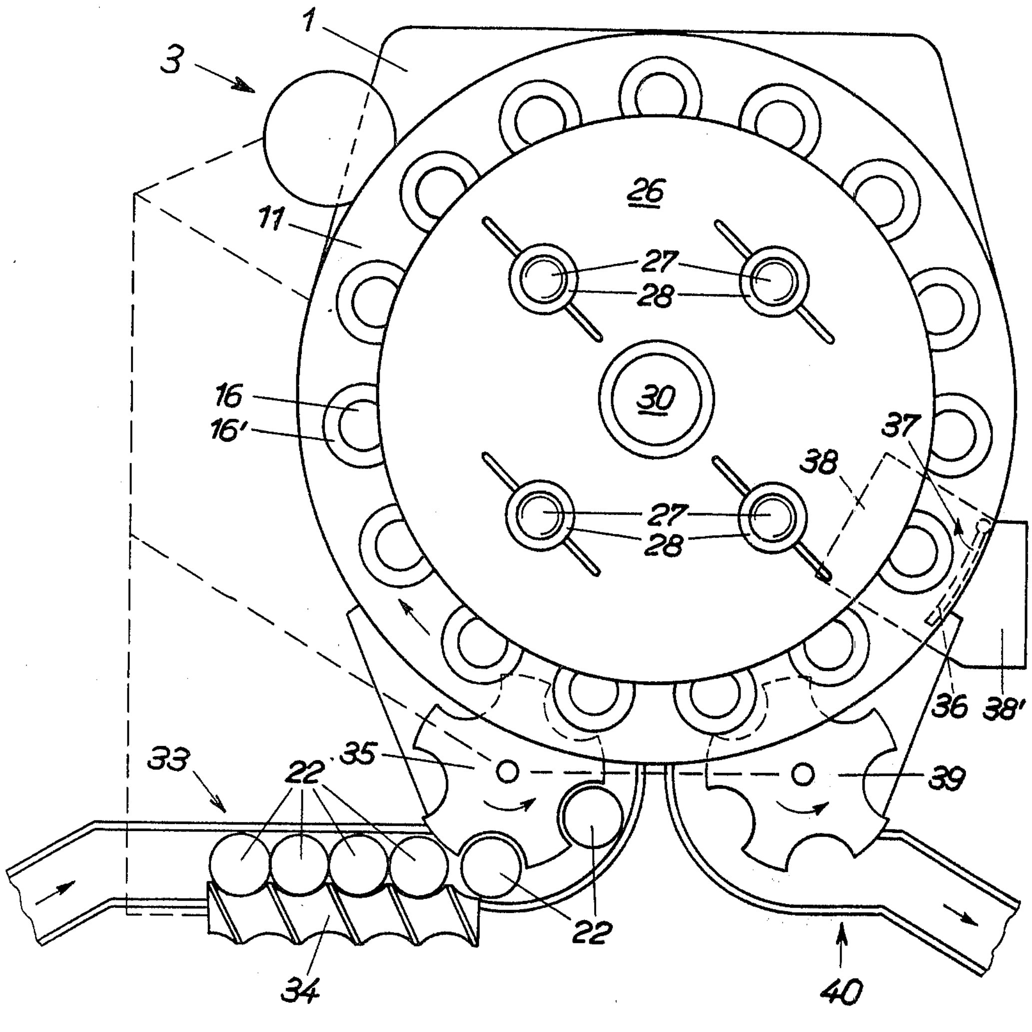


Fig.1



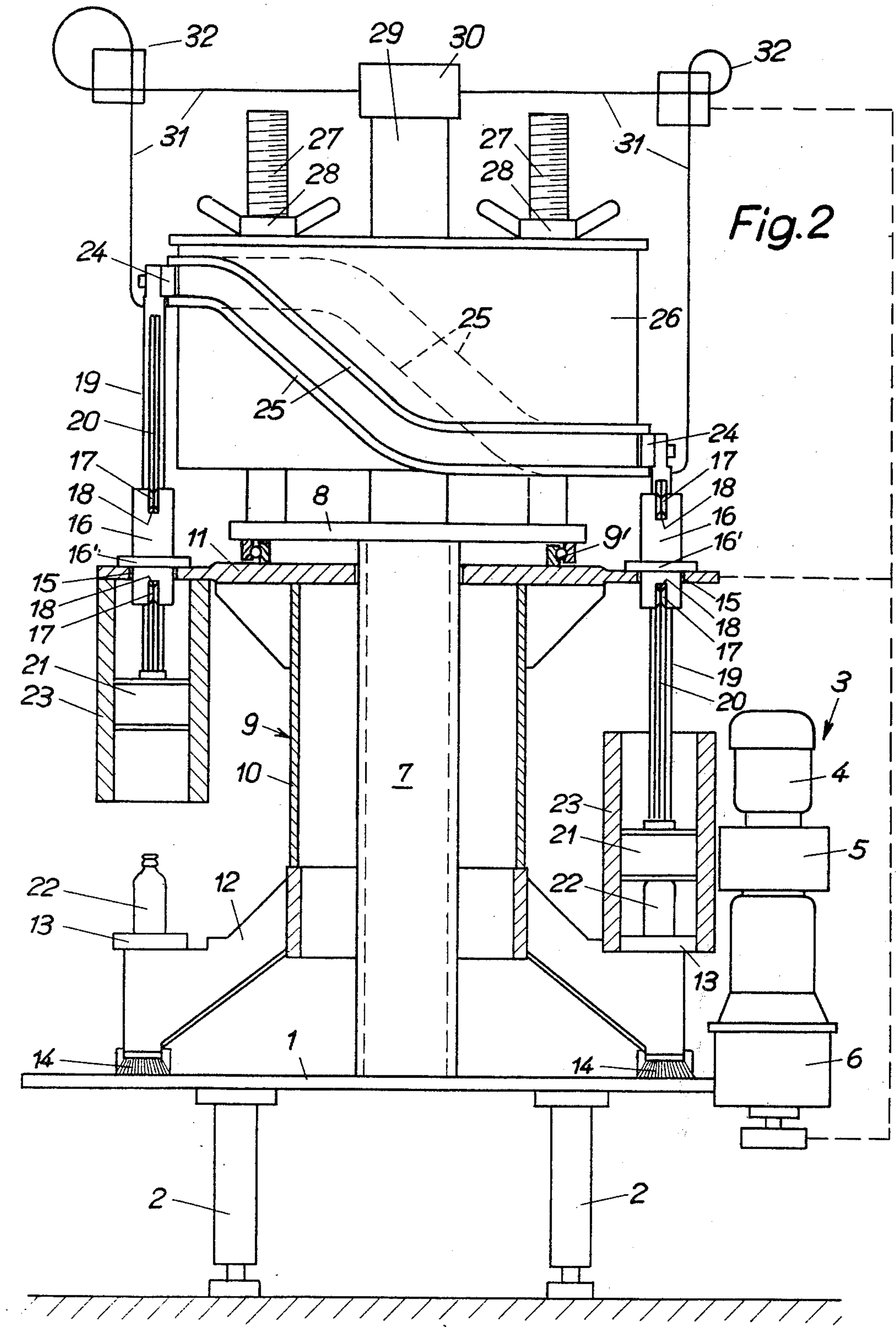

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Fig.2

Fig.3

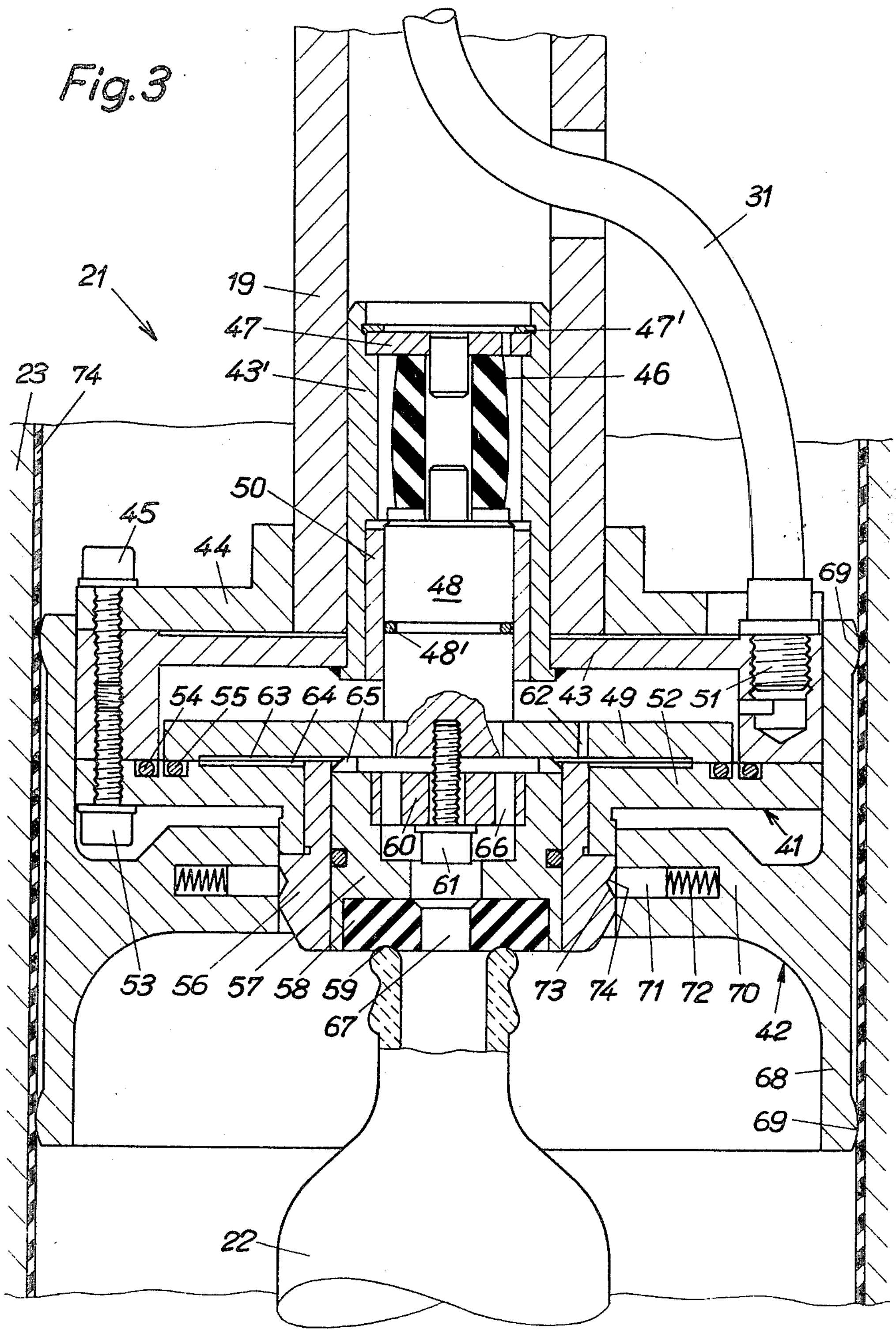
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Fig.4

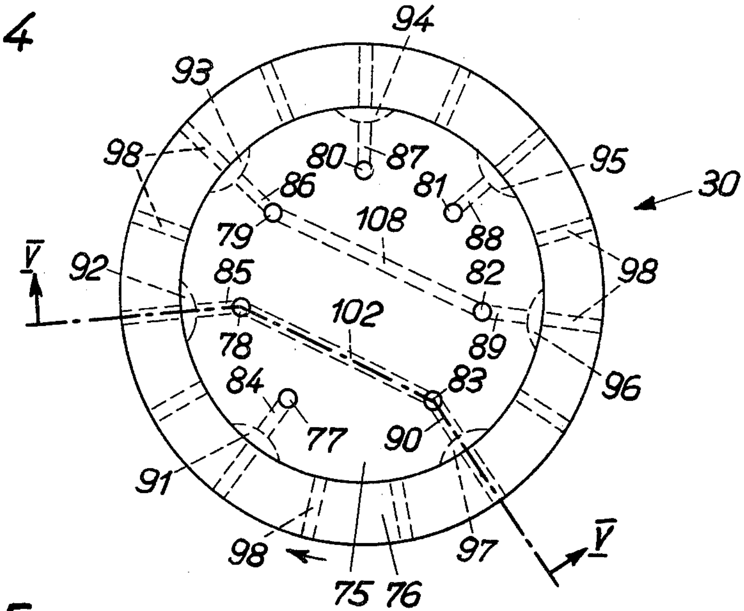


Fig.5

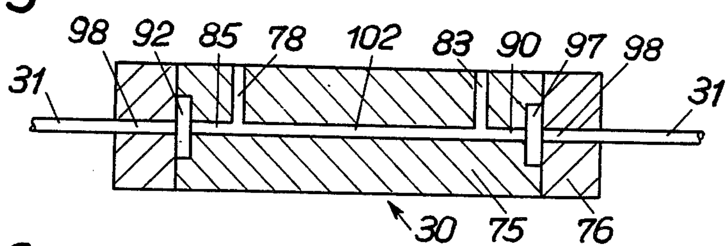


Fig.6

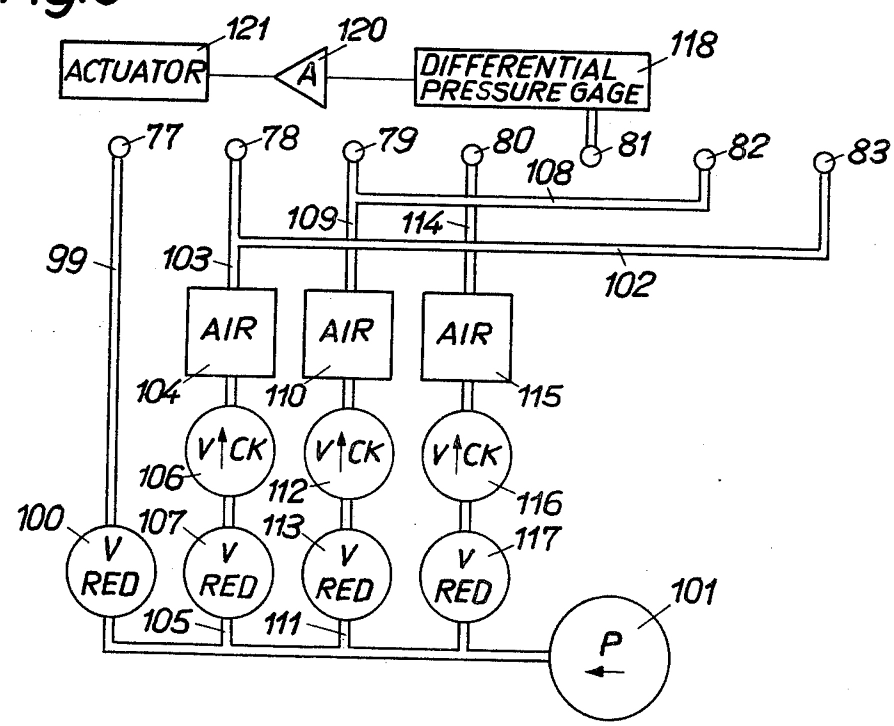
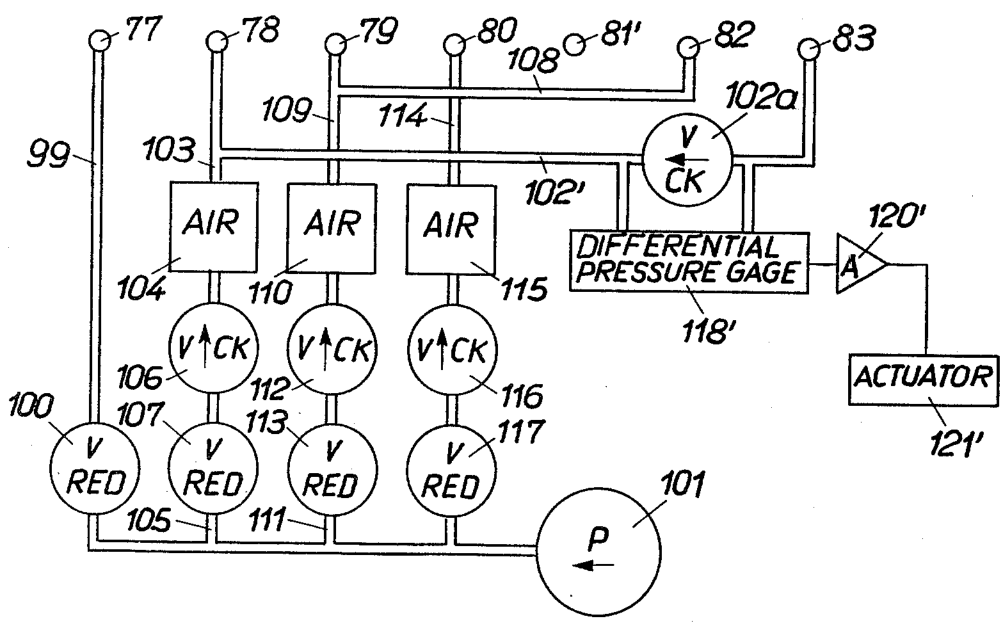


Fig. 7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BOTTLE SORTING APPARATUS

This invention relates to a sorting apparatus for bottles, and particularly to apparatus for testing bottles for strength and leak proofness and for separating bottles meeting the test from bottles which fail in one of the tests.

It is known to subject glass bottles intended for holding carbonated beverages to internal gas pressure of increasing strength and to sort the bottles according to their ability of withstanding the internal pressure and of holding the applied pressure when sealed U.S. Pat. No. 3,010,310; German published application No. 2,033,030). The known devices are relatively complex, requiring a multiplicity of valves and other movable elements. If it is desired further to test the bottles for their resistance to compressive stress, a feature important for bottles normally stacked for storage and during transportation, different additional apparatus needs to be employed.

It is the primary object of this invention to provide apparatus capable of sorting bottles not only according to their resistance to internal gas pressure and leak proofness, but also according to their resistance to compressive stress, and doing so in a simple manner employing a minimum of moving parts, and particularly few valves.

A further object is the provision of such apparatus which consumes relatively little compressed gas for testing bottles.

Yet another object is the provision of simple means for distinguishing between bottles failing and meeting the test requirements, and for accordingly actuating deflecting mechanism for deflecting defective bottles or their broken pieces from the path of bottles tested successfully.

With these and other objects in view, the invention provides a bottle carrier movable for carrying bottles sequentially through a plurality of testing stations and including a plurality of platforms and a sealing head associated with each platform. Each sealing head has a casing which bounds a chamber, a piston slidable in the casing inward and outward of the chamber and having a bottle neck engaging portion formed with a bore, and a shut-off valve communicating with the bore. The bottles to be tested are fed to the platforms at a feeding station and placed on associated platforms in a position in which the bottle axis extends away from the platform toward the associated sealing head.

A cam arrangement causes relative movement of the platform and sealing head in the direction of the bottle axis toward and away from a relative position in which the piston of the sealing head engages the bottle neck. A conduit is provided for connecting a source of gas under pressure to the chamber of the sealing head for biasing the piston outward of the chamber under gas pressure and for thereby exerting compressive stress on an engaged bottle. The cam arrangement causes relative movement of the platform and sealing head until a bottle having adequate resistance to the compressive stress moves the piston inward of the chamber in the sealing head against the gas pressure.

The shut-off valve responds to the inward piston movement by connecting the bore in the piston to the chamber and thereby admitting gas under pressure to the bottle through the engaged neck, whereby internal gas pressure is exerted on the bottle. The bottle, while under the internal gas pressure is sealed from the

source, and the maintenance of the internal pressure in the sealed bottle is sensed.

A deflector deflects the tested bottle or its broken pieces from the bottle carrier when actuated by an actuating mechanism in response to the failing of the tested bottle under the applied compressive stress or internal gas pressure, or its failing to maintain the internal pressure. The bottles not deflected because of defects are separately discharged from the bottle carrier at a discharging station.

Other features, additional objects, and many of the attendant advantages of this invention will readily be appreciated as the same becomes better understood from the following detailed description of a preferred embodiment when considered in connection with the appended drawing in which:

FIG. **1** shows bottle sorting apparatus of the invention in top plan view;

FIG. **2** illustrates the apparatus of FIG. **1** in fragmentary elevational section;

FIG. **3** shows a portion of the apparatus in elevational section on a scale much greater than that of FIGS. **1** and **2**;

FIG. **4** shows a rotary valve of the apparatus of FIG. **1** in a corresponding view on a larger scale;

FIG. **5** is a view of the device of FIG. **4** in section on the line V—V;

FIG. **6** illustrates the pneumatic and electric circuits associated with the device of FIG. **4** in a conventional manner; and

FIG. **7** shows a modification of the apparatus shown in FIG. **6**.

Referring now to the drawing in detail, and initially to FIGS. **1** and **2**, there is seen a base plate **1** mounted on levelling legs **2** which supports the operating elements of the apparatus and its drive mechanism essentially consisting of an electric motor **4**, a coupling **5**, and a reducing transmission **6** connected to the motor **4** by the coupling **5**. The timing belts, link chains, and countershafts which connect the output pulley of the transmission **6** to driven elements of the apparatus have been indicated in a conventional manner by broken lines.

A heavy column **7** centered on the base plate **1** holds a fixed, horizontal support plate **8**. A balanced rotor **9** is suspended from the plate **8** by means of an annular bearing **9'** coaxial with the column **7**. The rotor **9** includes a cylindrical shell **10** and a radial flange **11** on the upper axial end of the shell **10**, the flange being fastened to the movable part of the bearing **9'**. Fifteen brackets **12** project radially outward from the lower end of the shell **10** in equiangularly spaced relationship about the vertical axis of rotation. Each bracket **12** carries an upwardly directed circular, horizontal platform **13** and a downwardly directed brush **14** which sweeps the plate **1** when the rotor **9** is turned by the motor **4** and the non-illustrated timing belt which connects the transmission **6** to the flange **11**.

Fifteen openings in the circumference of the flange **11** are vertically aligned with respective platforms **13** and receive respective tubes **16**. An outer, radial flange **16'** on each tube **16** rests on the top surface of the flange **11** and may be fixedly fastened to the flange if so desired. Two pairs of guide wheels **17** vertically and coaxially guide a tubular push rod **19** in each tube **16**, axial ribs **20** on the rod **19** being partly received in the circumferential grooves **18** of the wheels **17**. The lower end of each rod 21 carries a sealing head 21 for engagement with a bottle 22 on the associated platform 13. A cylindrical shield 23 is secured to each head 21.

The top of each rod 19 carries a cam follower wheel 24 which is received in a cam track 25 on the cylindrical surface of a drum 26. The drum is mounted on the fixed plate 8 by means of partly threaded vertical spindles 27. Wing nuts 28 on the spindles may be adjusted to secure the vertical spacing of the drum 26 from the plate 8, and thereby to determine the vertical position of the path travelled by the testing heads 21 from the platforms 13.

A column 29 fixedly mounted on the plate 8 carries a rotary distributor valve 30. Pressure hoses 31 connect respective outlets of the valve 30 with the 15 testing heads 21. A retractor 32 between two sections of each hose 31 permits the hose to follow the vertical movement of the associated head 21 during angular movement of the rotor 9 as the wheels 24 follow the cam track 25 which has two horizontal sections connected by oblique ramps. The vertical spacing of the two horizontal sections of the cam track 25 is equal to the difference between the axial length of each shield 23 and the distance between the flange 11 and each bracket 12. As is not specifically shown, the retractors 32 are mounted on the rotor 9, and the hoses 31 are stiff enough to turn the rotary portion of the valve 30 in precise synchronization with the rotor 9.

As is best seen in FIG. 1, bottles 22 are fed to the platforms 13 by a conveyor 33 including a screw 34 and by a circumferentially notched wheel 35 which are driven by the motor 4 in precise synchronization with the rotor 9. The rotor turns clockwise, as viewed in FIG. 1, and the loading station defined by the wheel 35 is vertically aligned with the trailing end of the higher section of the cam track 25 so that the testing heads 21 do not interfere with the radial movement of the bottles 22 whose bottoms are placed on the platforms 13.

The leading end of the elevated track section is aligned with a deflector arm 36 which may be swung from the rest position shown in FIG. 1 in the direction of the arrow 37 by a solenoid, not shown in FIG. 1, for deflecting a selected bottle 22 on the rotor 9 into the orifice 38 of a chute 38′ and to waste. Bottles not deflected by the arm 36 are pushed from the platforms 13 by a driven wheel 39, analogous to the wheel 35, to a chute 40 and to a packing station, not shown, as indicated by an arrow.

The lower end of a rod 19 and the associated testing head 21 are shown in more detail in FIG. 3. The principal elements of the head 21 are a shut-off valve 41 and a mounting ring 42. The casing of the valve 41 has an upper portion 43 fixedly fastened to the rod 19 by a flange 44 on the latter and circumferentially distributed bolts 45 of which only one is seen in the drawing. A sleeve 43′ welded to the casing part 43 conformingly extends into the bore of the rod 19. A heavy tubular rubber cushion 46 is coaxially secured in the sleeve 43′ against upward displacement by a disc 47 and a snap ring 47′. The ring 47′ backs the disc 47 and is held in a groove of the sleeve 43′.

An antifraction bushing 50 in the sleeve 43′ coaxially guides a piston 48 and is engaged by a sealing ring 48′ on the piston. Coaxial pins on opposite radial faces of the piston 48 and of the disc 47 hold the cushion 46 in its coaxially centered position. The lower end of the piston 48 carries a flat, circular valve disc 49. The axially relatively wide, annular chamber of the valve 41 between the disc 49 and the valve casing portion 43 communicates through a nipple 51 with the hose 31 associated with the testing head 21, the hose being partly guided in the bore of the rod 19.

The lower portion 52 of the valve casing is secured to the upper casing portion 43 by the bolts 45 and nuts 53 on the bolts. The two casing portions are sealed to each other by a sealing ring 54. A similar ring 55 seals the circumference of the valve disc 49 to the lower casing portion 52 in the illustrated closed position of the disc 49.

A central axial bore in the casing portion 52 is lined with a coaxial anti-friction bushing 56, and a piston 57 is slidably received in the bushing. A recess in the radial bottom face of the piston 57 receives an annular sealing disc 58 of relatively stiff synthetic rubber which, in the illustrated condition of the apparatus, engages the rim 59 on the neck of a tested bottle 22. The piston 57 is fixedly fastened to the valve disc 49 by a spider 60 and a central screw 61.

Gas may flow slowly from the nipple 51 to the bottle 22 past the sealing ring 55 through a restricted passage including an axial bore 62 in the disc 49, radial grooves 63,64 in the lower face of the disc 49 and the top face of the casing 52, an annular space 65 between the disc 49 and the piston 57, and openings 66, 67 in the spider 60 and in the annular seal 58.

The mounting ring 42 has an approximately cylindrical, tubular part 68 from which two axially spaced, integral, annular, circumferential beads 69 project in a radially outward direction for frictional engagement with a rubber liner 74 vulcanized to the inner face of the associated shield 23. A flange 70 projecting from the ring part 68 in a radially inward direction receives pins 71 in respective radial bores. Helical compression springs 72 back the pins and hold the conical free ends of the pins engaged with conforming recesses 73 in the bushing 56, thereby providing a firm, but releasable connection between the ring 42 and the valve casing 43,52.

The distributor valve 30 is shown in greater detail in FIGS. 4 and 5. A central part 75 of the valve 30 is fixedly mounted on the column 29. Its cylindrical circumference is movably sealed to the valve rotor 76 which is an axially short, tubular cylinder. Seven orifices 77 to 83 in the top surface of the central valve part 75 lead into respective radial bores 84 to 90 which terminate in recesses 91 to 97 spaced from each other in the circumferential surface of the valve part 75 and sealed in both axial directions. The recesses 92,97 are connected by a bore 102 in the valve part 75 between the orifices 78,83 and a bore 108 similarly connects the orifices 79,82 and the associated recesses 93,96. Fifteen equiangularly spaced radial bores 98 in the valve rotor 76 sequentially sweep the recesses in the valve part 75 and are connected to respective testing heads 21 by pressure hoses 31 as is shown in FIG. 1.

The pneumatic circuit of the stationary valve part 75, largely omitted from FIGS. 1 to 5, and associated electrical elements are shown in FIG. 6. A conduit 99 equipped with a pressure reducing valve 100 connects the orifice 77 to the discharge pipe of an air compressor 101. The orifices 78,83 and the bore 102 are connected by a conduit 103 to an air vessel 104 which in turn is connected to the compressor 101 by a conduit 105 provided with a check valve 106 and a pressure reducing valve **107.** The connected orifices **79,83** are similarly connected with the compressor **101** through a conduit **109,** an air vessel **110,** another conduit **111,** a check valve **112,** and a pressure reducing valve **113.** A conduit **114,** air vessel **115,** check valve **116,** and pressure reducing valve **117** connect the orifice **80** with the compressor **101.**

A differential pressure gage **118** is connected to the orifices **80** and **81** and generates an electrical signal in an electric control circuit **119** when the pressures at the connected orifices differ significantly. The signal is amplified by an amplifier **120** equipped with a time delay dircuit, and the amplified signal is transmitted after a delay set in the amplifier **120** to the electro-magnetic actuator **121** which swings the deflector arm **36** into the path of the bottles **22** long enough to deflect a selected bottle into the chute **38'**.

The compressor **101** is equipped with a pressure relief valve (not shown) which vents the discharge conduit of the compressor when the pressure exceeds 250 p.s.i. The pressure reducing valves **100, 107, 113,** and **117** maintain respective pressures of 190 p.s.i. at the orifice **77,** 94 p.s.i. in the air vessel **104,** 160 p.s.i. in the air vessel **110,** and 240 p.s.i. in the air vessel **115,** all pressure values being gage pressures.

When the motor **4** and the compressor **101** are energized, the apparatus illustrated in FIGS. **1** to **6** operates as follows:

Bottles **22** to be tested are fed in a continuous stream by the conveyor **33** to the testing apparatus proper, one bottle **22** being deposited on each platform **13** as the platforms travel past the feeding station at the wheel **35.** The descending ramp of the cam track **25** lowers the associated sealing head **21** on the tested bottle **22** shortly after the bottle leaves the feeding station, whereby the seal **58** engages the bottle rim **59.** At this stage, the radial bore **98** associated with the tested bottle communicates with the recess **91** in the stationary valve part **75,** and the air pressure of 190 p.s.i.g. prevailing at the orifice **77** is established in the valve chamber between the valve casing part **43** and the valve disc **49.** Downward movement of the sealing head **21** along the cam track **25** continues until the resistance of the bottle **22** to further downward movement of the piston **57** causes the valve disc **49** to be lifted from the sealing ring **55** against the air pressure in the valve chamber.

The horizontal top face of the valve disc **49** is dimensioned so that the axial force exerted on the bottle by the piston **58** reaches a maximum of about 1750 lbs. shortly before the valve disc is lifted from the sealing ring **55.** Immediately thereafter, the bore **98** travels beyond the recess **91** so that the pressure in the valve chamber is quickly dissipated in the bottle through the opened valve **41** whose flow section is so much greater than that of the throttling passage **62 – 66** that the effect of the latter on pressure distribution at the first testing station is negligible.

Seriously defective bottles **22** are destroyed by the vertical pressure applied at the first testing station, and the broken pieces are contained by the shield which descends with the head **21.** The pressure in the valve chamber is bled to the atmosphere through the throttling passage **62 – 66.**

If the bottle **22** passes the first test, it remains in communication with the associated hose **31** and bore **98** through the open valve **41,** and the bottle **22** as well as the valve chamber are sealed from the atmosphere by the sealing disc **58** under the pressure of the rubber cushion **46.** The bottle is exposed next to an internal pressure of 94 p.s.i. as the associated bore **98** communicates with the recess **92** and the orifice **78.** Unless the bottle is exploded by the applied air pressure, it is subsequently tested at 160 and 240 p.s.i.g. when the associated bore **98** sweeps the recesses **93, 94.**

If the bottle **22** survived so far, and if the bottle rim **59** is smooth enough for tight engagement by the disc **58,** the internal pressure of 240 p.s.i.g. should be maintained thereafter, and the pressure at the orifice **81** should reach a value closely approaching 240 p.s.i.g. when the bore **98** associated with the tested bottle **22** communicates with the recess **95** during the continuing movement of the rotor **9.** A pressure of 240 p.s.i.g. is maintained at the orifice **80** whether or not it communicates with a bottle, and the similar pressure in the tested bottle **22** communicating with the orifice **81** thus does not produce a significant pressure difference reading on the gage **118,** nor a signal to be transmitted to the actuator **121.**

The tested bottle is gradually relieved of its internal pressure by sequential connection to the air vessels **110, 115** as its associated hose **31** is connected to the recesses **96,97.** Immediately thereafter, the sealing head **21** is lifted from the tested bottle by the ascending ramp of the cam track **25,** and the bottle **22,** having passed tests for external and internal pressure, is discharged by the wheel **39** from the platform **13** to the discharge chute **40.**

If a tested bottle is destroyed either by the axial pressure applied in the first testing station, or by internal air pressure at the second, third, or fourth station, the associated valve **41** is closed by the rubber cushion **46,** but the throttling passage **62 – 66** dissipates the air pressure built up at each testing station before the valve communicates with the next recess in the stationary valve part **75.**

When a sealing head **21** not engaged by a complete bottle **22,** engaged by a leaking bottle, or engaged by a bottle having a defective rim **59** so as not to form a tight seal, travels past the fourth testing station, its internal pressure drops so that a signal is generated by the gage **118,** and is stored in the amplifier **120** until the sealing head approaches the deflector **36.** The electromagnetic actuator **121** then receives the amplified signal and moves the deflector **36** into the path of the defective bottle or of the broken pieces of the defective bottle on the platform **13.** The bottle or the glass pieces are swept into the chute **38'** by the deflector which is held in the deflecting position by a holding circuit in the actuator **121,** conventional and not shown in detail. The deflector thereafter is returned to its illustrated inoperative position by a non-illustrated return spring.

The complete testing cycle for a bottle in good condition consumes only an amount of air defined by the capacity of the bottle and the pressure of the testing gas at the second testing station, that is, 94 p.s.i.g. in the specific embodiment described. This amount of compressed gas is ultimately lost when the sealing head **21** is lifted from the tested bottle prior to discharge of the bottle from the carrier rotor **9.** All other compressed gas employed during the test is recuperated by the bores **108, 102** through wich bottles already tested at higher internal pressure discharge their contents into bottles in which a testing pressure is being built up. The air vessels **104, 110** receive air from the compressor

101 only for making up minor leakage losses if all bottles survive the tests. The loss of compressed gas from defective bottles is small, and is insignificant under practical conditions when only a very small percentage of the bottles is destroyed in the tests.

All operations, including testing for compression resistance under external axial stresses and testing for resistance to internal gas pressure, are controlled by the single distributor valve, and the shut-off valve **41** in each sealing head **21** serves the dual function of converting gas pressure into compressive stress applied to the tested bottles, and preventing excessive losses of compressed gas when a bottle fails, and also when no bottle is fed to a platform **13**.

The apparatus is readily adjusted for bottles of different height by shifting the drum **26** on the spindles **27**, and turning the rotor **9** through one revolution. If the drum **26** is raised to accomodate taller bottles, the shields **23** associated with sealing heads **21** in the upper or inoperative position cannot move upward because of their abutting engagement with the flange **11**, and the sealing heads **21** are pulled upward relative to the shields against the frictional resistance offered by the beads **69** engaging the liner **74**. The shields **23** associated with heads **21** initially in the lower or operative position are merely lifted from the platforms **13** during upward adjustment of the drum. During subsequent rotation of the rotor **9**, the push rods **19** pull the shields into engagement with the flange **11** and further pull the sealing heads **21** upward relative to the shields until all sealing heads and shields are in the desired position in which the sealing heads **21** properly engage the bottles to be tested, and the shields **23** move between respective positions of abutment against the flange **11** and the brackets **12**.

The manner of adjusting the apparatus for testing smaller bottles will be obvious from the above. The size of the bottle mouth may be chosen freely without machine adjustment within the radial dimensions of the annual sealing disc **58**. However, bottles having even wider or narrower mouths than can be handled by the disc **58** may be tested after releasing the screw **61**, and replacing the piston **48** by one having a seal of suitable dimensions, the use of a seal axially projecting downward from the bushing **56** and having an effective diameter greater than that of the bushing being specifically contemplated.

A modification of the pneumatic and electric circuits in the afore-described apparatus is illustrated in FIG. **7**. The modified apparatus differs from the structure illustrated in FIGS. **1 – 5** only by a check valve **102**a in the bore **102'** which connects the orifices **78,83**. The check valve permits fluid flow only from the recess **97** toward the orifice **78**, the recess **92**, and the air vessel **104**, but not in the opposite direction.

The orifice **81** is closed by a plug **81'**, and the differential pressure gage **118** is replaced by a similar gage **118'** connected to the bore **102'** at opposite ends of the check valve **102*a***. A signal generated by the gage **118'** in response to a sensed pressure difference is amplified by an amplifier **120'** to energize the actuator **121** of the deflector **37** after an appropriate delay.

The device of FIG. **7** operates in a manner similar to that described with reference to FIGS. **1** to **6**. A bottle is first tested under axial compression and thereafter at three stations under internal air pressure which is increased in steps to a maximum pressure when the bottle communicates with the orifice **80**.

The bore **98** associated with the tested bottle thereafter travels past the recess **95** without significant pressure loss it the bottle is in acceptable condition and reaches the recess **96** which communicates with the air vessel **110** while still containing air at a pressure higher than that maintained in the vessel **110** and the communicating conduits by the pressure reducing valve **113**. A short pulse of air therefore flows from the bottle toward the vessel **110** through the bore **108**. The same procedure is repeated when the bottle communicates with the air vessel **106** in which the pressure is lower than that of the vessel **110**. A pulse of air flows through the bore **102'**, opens the check valve **102*a***, and does not establish a significant pressure differential across the check valve **102**a that could induce the gage **118'** to generate a signal.

If a broken bottle is carried on a platform **13**, the valve **41** of the associated sealing head **21** loses pressure through its throttling passage **62 – 66**, and connects the orifice **83** to the atmosphere when the associated bore **98** registers with the recess **97**. The valve **102*a*** prevents the escape of compressed air from the vessel **103**, but the gage **118'** generates a signal which will cause the defective bottle or its broken pieces to be swept from the platform **13** by the deflector **37**, as described above.

Leakage or other defects in a tested bottle can be discovered in an analogous manner by installing a check valve in the bore **108** in association with a differential pressure gage in a manner obvious from FIG. **7**. It is also possible to increase or decrease the number of stages in which internal pressure is built up to maximum testing pressure and thereafter again released in steps to avoid damage to the bottle under conditions not simulating those encountered in actual service. Other modifications of the illustrated embodiments of the invention will readily suggest themselves to those skilled in the art.

While the illustrated rotary valve **30** has an inner, stationary part of circular cross section and an outer movable part which is annular and envelops the stationary part, so that respective bores of the two parts communicate with each other along a cylindrical interface, the two valve parts may both be disc-shaped and axially superposed for communication between respective bores through an interface which is radial or otherwise transverse to the axis of rotation.

The illustrated spatial relationship of stationary valve part **75** and valve rotor **76** may be reversed by directly mounting a central valve rotor on the rotor **9** and providing an annular stationary valve part fixedly supported on the column **29** and enveloping the valve rotor. This arrangement may be further modified by the use of axially superimposed valve parts as discussed above.

A rotor **9** has been illustrated and described as a carrier for the platforms **13**, but the platforms may travel in a path which is not a circle above a fixed axis, and the cam track **25** may be modified accordingly. Thus, the platforms **13** may travel on a chain conveyor in any closed loop which may be flat or which may rise and fall in a manner complementary to the illustrated configuration of the cam track **25** for causing engagement between the sealing heads **21** moving in a horizontal plane and the tested bottles **22** in a manner not significantly different from that shown in FIG. **3.**

Other design choices are available, but the illustrated arrangement has been found superior to the various modifications mentioned because of its simplicity and corresponding ruggedness and reliability.

It should be understood, however, that the foregoing disclosure relates only to preferred embodiments of the invention, and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purpose of the disclosure which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

What is claimed is:

1. Apparatus for sorting bottles having each an axis, a bottom at one axial end, and a neck at the other axial end according to their compressive strength, resistance to internal gas pressure, and leak proofness comprising, in combination:

a. bottle carrier means movable for carrying a plurality of bottles sequentially through a plurality of stations, said bottle carrier means including
  1. a plurality of platforms,
  2. a sealing head associated with each platform and including
    i. a casing bounding a chamber therein,
    ii. a piston slidable in said casing inward and outward of said chamber and having a bottle neck engaging portion formed with a bore, and
    iii. shut-off valve means communicating with said bore;

b. feeding means for feeding respective bottles to said platforms at a feeding station and for placing each bottle on the associated platform in a position in which the axis of said bottle extends away from said platform toward the associated sealing head;

c. cam means for causing relative movement of said platform and of said sealing head in the direction of said axis toward and away from a relative position in which said portion engages the neck of a bottle placed on the associated platform;

d. at least one source of gas under pressure;

e. conduit means connecting said at least one source to said chamber for biasing said piston outward of said chamber under the pressure of said gas and for thereby exerting compressive stress on a bottle engaged by said portion,
  1. said cam means including means for causing said relative movement of said platform and said sealing head until a bottle having adequate resistance to said compressive stress moves said piston inward of said chamber,
  2. said valve means responding to said inward movement of said piston by connecting said bore to said chamber and thereby admitting gas under pressure to said bottle through the engaged neck, whereby internal gas pressure is exerted on said bottle;

f. sealing means for sealing said bottle from said source while under said internal gas pressure;

g. sensing means for sensing the maintenance of said internal pressure in the sealed bottle;

h. deflecting means for deflecting a tested bottle from said bottle carrier means;

i. actuating means for actuating said deflecting means in response to the failing of said tested bottle under said compressive stress, failing of the tested bottle under the internal pressure of the admitted gas, or failing of the tested bottle to maintain said internal pressure;

j. discharge means for discharging the bottles not deflected by said deflecting means from said bottle carrier means; and

k. a tubular shield fastened to each of said sealing heads for movement therewith relative to the associated platform for enveloping a bottle placed on said platform when said sealing head and said platform are in said relative position thereof, said cam means including means for keeping said sealing head and said shield remote from said platform while said feeding means feed a bottle to the associated platform and said discharge means discharge a bottle from said platform.

2. Apparatus as set forth in claim **1,** comprising a plurality of said sources, the respective gas pressure of at least two of said sources being different, said conduit means including a plurality of first conduits respectively communicating with the chambers of said sealing heads, a plurality of second conduits respectively communicating with said sources, and distributor valve means operable for connecting each of said first conduits sequentially to each of said second conduits, said apparatus further comprising drive means for moving said bottle carrier means and operating said distributor valve means in timed sequence.

3. Apparatus as set forth in claim **2,** wherein said distributor valve means include first and second valve parts formed with respective pluralities of spaced bores, the bores of said first valve part communicating with said first conduits respectively, and respective bores of said second valve part communicating with said second conduits, and said drive means moving said valve parts relative to each other for sequential communication of said first and second bores, said distributor valve menas consituting said sealing means when the first bore communicating with said sealed bottle is out of communication with all said second bores.

4. Apparatus as set forth in claim **3,** wherein one of the bores of said first valve parts sequentially communicates with the bores of a group of three bores in said second valve part during said operating of said distributor valve means, the first and third bores of said group communicating with each other and with one of said two sources having gas of lower pressure than the other source, and the second bore of said group communicating with said other source, said actuating means including means for detecting flow of gas inward of said third bore toward said first bore and for actuating said deflecting means in the absence of detected inward flow.

5. Apparatus as set forth in claim **4,** wherein said flow detecting means include a check valve in said third bore and a differential pressure gage connected to said check valve for detecting a pressure differential across said check valve and for actuating said deflecting means in response to said absence.

6. Apparatus as set forth in claim **3,** wherein said actuating means include a differential pressure gage communicating with said sealed bottle and with said source of gas under pressure sealed from said bottle in a predetermined relative position of said valve parts, and operatively connected to said deflecting means for actuating the same in response to a predetermined pressure differential between the last-mentioned source and said sealed bottle.

7. Apparatus as set forth in claim 1, further comprising fastening means frictionally fastening each shield to the associated sealing head, adjusting means for adjusting the spacing of said sealing head and of the associated platform in said relative position, and abutment means for shifting said shield relative to said associated sealing head in response to said shifting and for thereby keeping the engaged bottle enveloped by said shield in the bottle neck engaging position of said sealing head.

8. Apparatus for sorting bottles having each an axis, a bottom at one axial end, and a neck at the other axial end according to their compressive strength, resistance to internal gas pressure, and leak proofness comprising, in combination:

a. bottle carrier means movable for carrying a plurality of bottles sequentially through a plurality of stations, said bottle carrier means including
   1. a plurality of platforms,
   2. a sealing head associated with each platform and including
      i. a casing bounding a chamber therein,
      ii. a piston slidable in said casing inward and outward of said chamber and having a bottle neck engaging portion formed with a bore,
      iii. shut-off valve means communicating with said bore and movable between an open position and a closed position, and
      iv. yieldably resilient means biasing said shut-off valve means toward the closed position and biasing said piston outward of said chamber toward a position of sealing engagement with a bottle on the associated platform while said shut-off valve means is in the open position, and means defining a throttling passage connecting the chamber of said sealing head with said bore;

b. feeding means for feeding respective bottles to said platforms at a feeding station and for placing each bottle on the associated platform in a position in which the axis of said bottle extends away from said platform toward the associated sealing head;

c. cam means for causing relative movement of said platform and of said sealing head in the direction of said axis toward and away from a relative position in which said portion engages the neck of a bottle placed on the associated platform;

d. at least one source of gas under pressure;

e. conduit means connecting said at least one source to said chamber for biasing said piston outward of said chamber under the pressure of said gas and for thereby exerting compressive stress on a bottle engaged by said portion,
   1. said cam means including means for causing said relative movement of said platform and said sealing head until a bottle having adequate resistance to said compressive stress moves said piston inward of said chamber,
   2. said valve means responding to said inward movement of said piston by moving from said closed position to said open position thereof and thereby connecting said bore to said chamber to admit gas under pressure to said bottle through the engaged neck, whereby internal gas pressure is exerted on said bottle;

f. sealing means for sealing said bottle from said source while under said internal gas pressure;

g. sensing means for sensing the maintenance of said internal pressure in the sealed bottle;

h. deflecting means for deflecting a tested bottle from said bottle carrier means;

i. actuating means for actuating said deflecting means in response to the failing of said tested bottle under said compressive stress, failing of the tested bottle under the internal pressure of the admitted gas, or failing of the tested bottle to maintain said internal pressure; and

j. discharge means for discharging the bottles not deflected by said deflecting means from said bottle carrier means.

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