

June 20, 1944.

W. J. FEDORCHAK ET AL

2,352,091

APPARATUS FOR GAUGING GLASSWARE

Filed Feb. 5, 1941

12 Sheets-Sheet 1

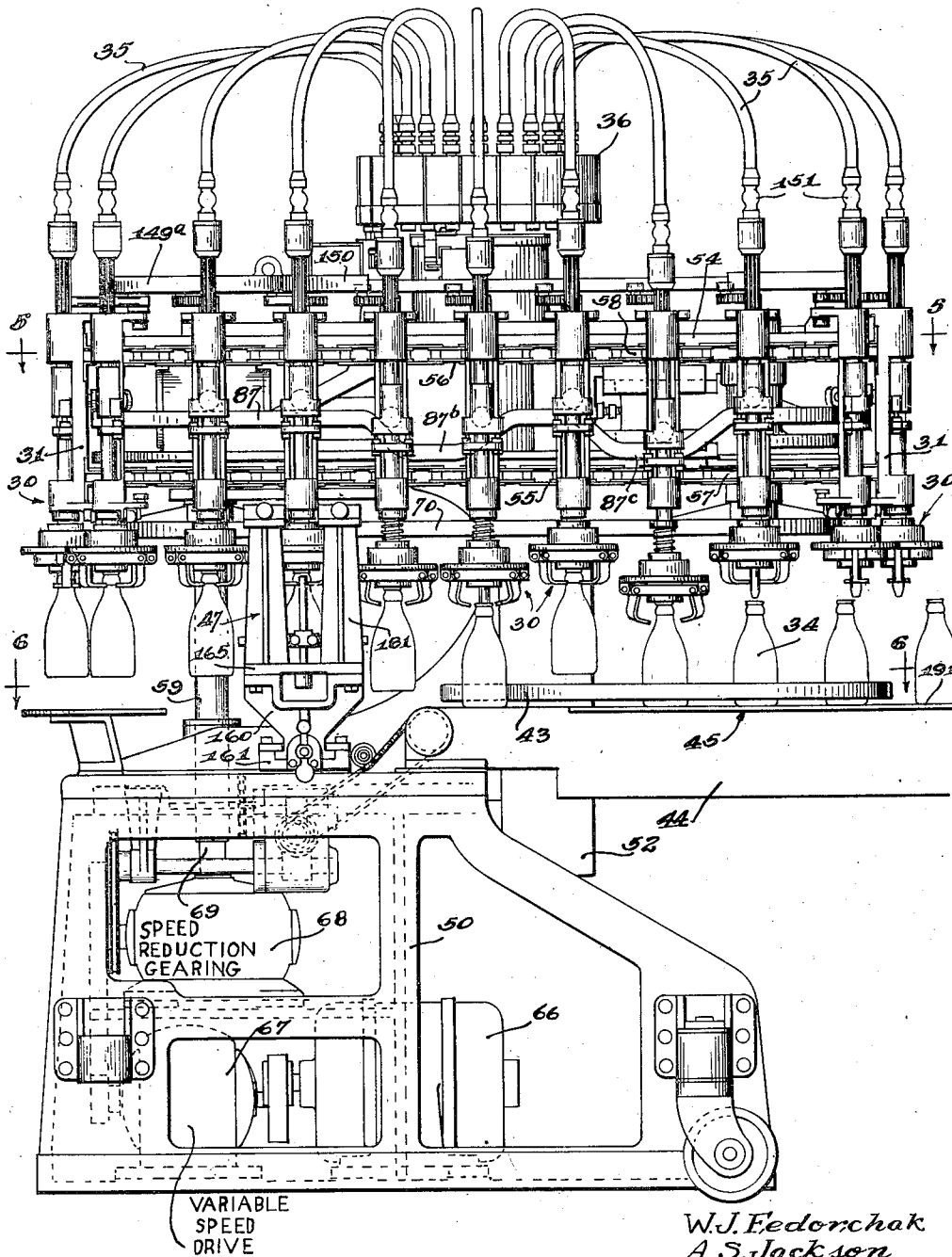


Fig. 1.

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12 Sheets-Sheet 2

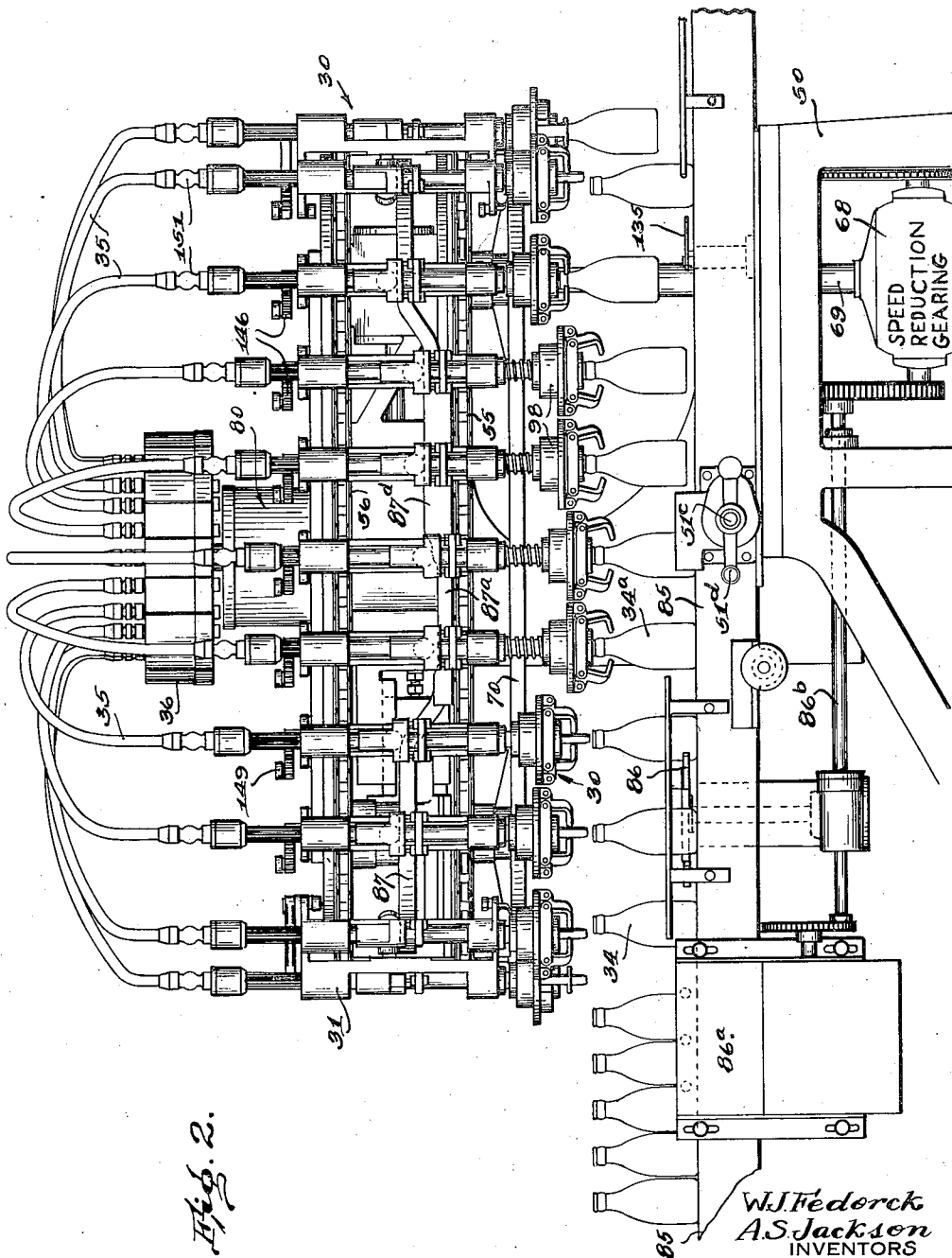


Fig. 2.

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12 Sheets-Sheet 3

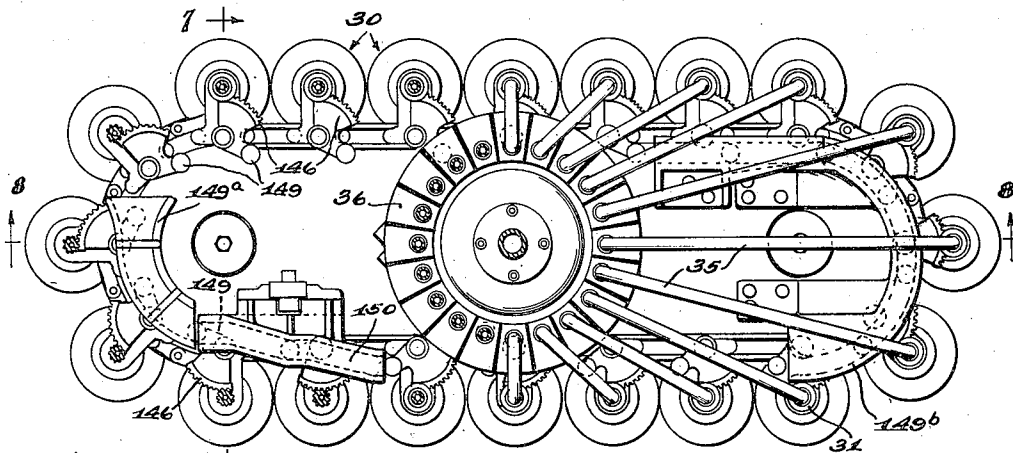


Fig. 3. 7+

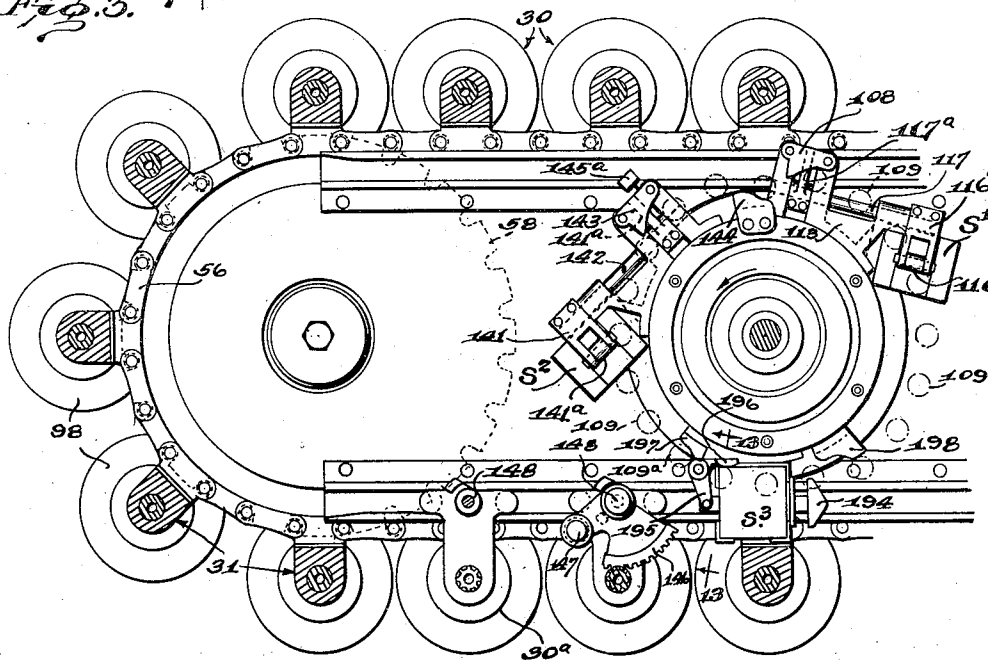
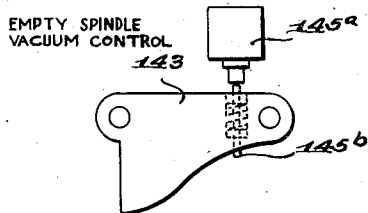


Fig. 4.



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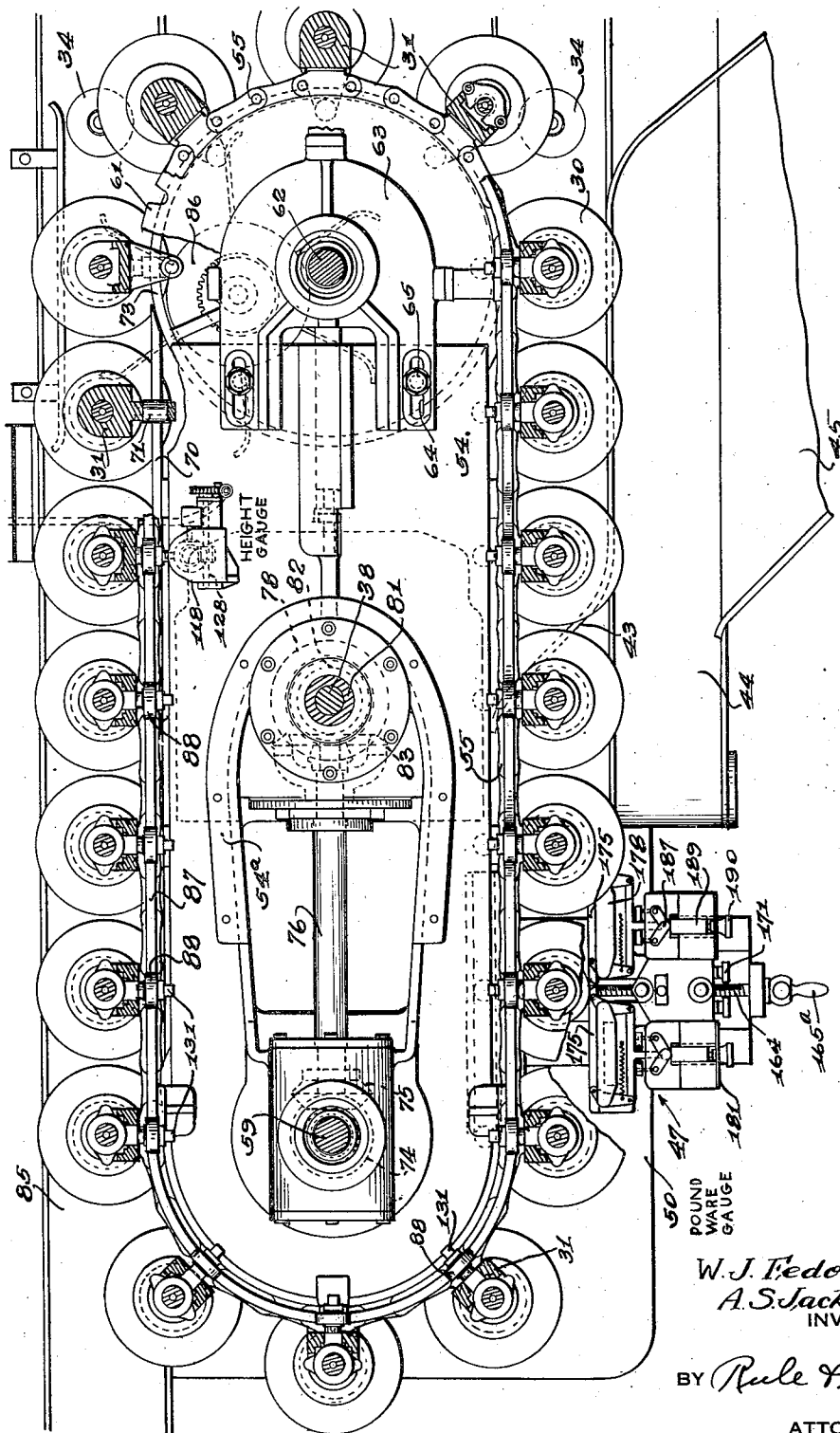
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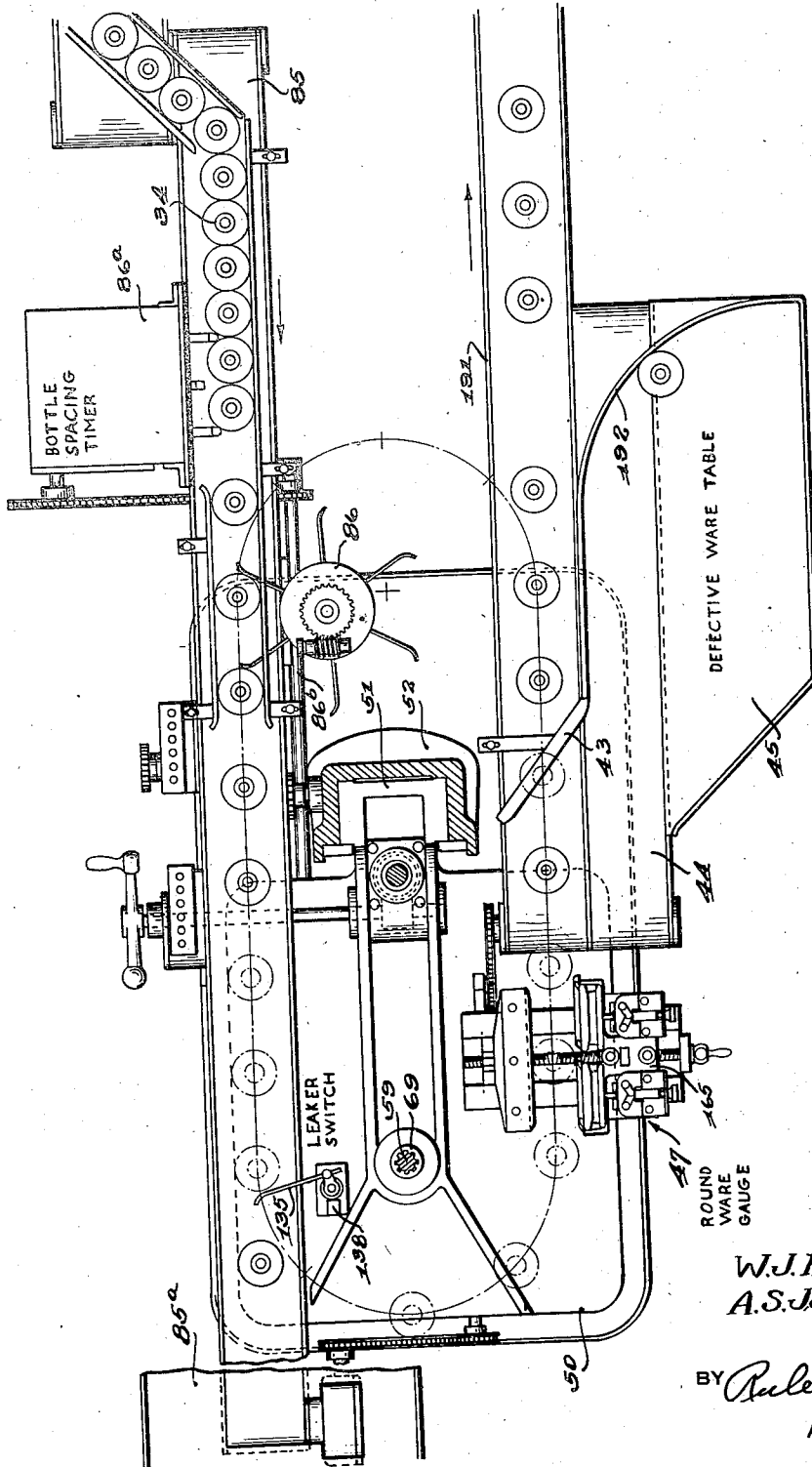


Fig. 6.

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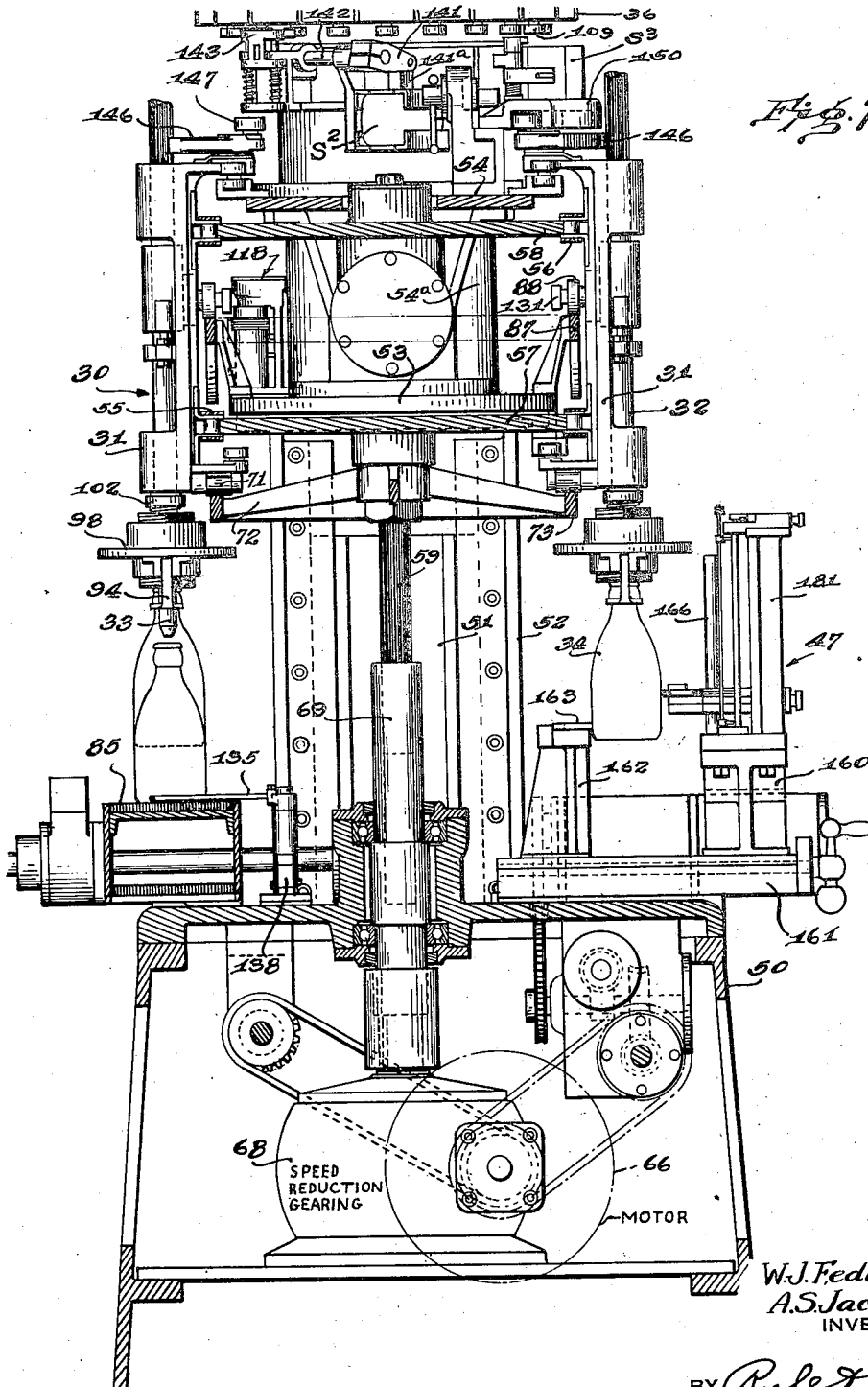
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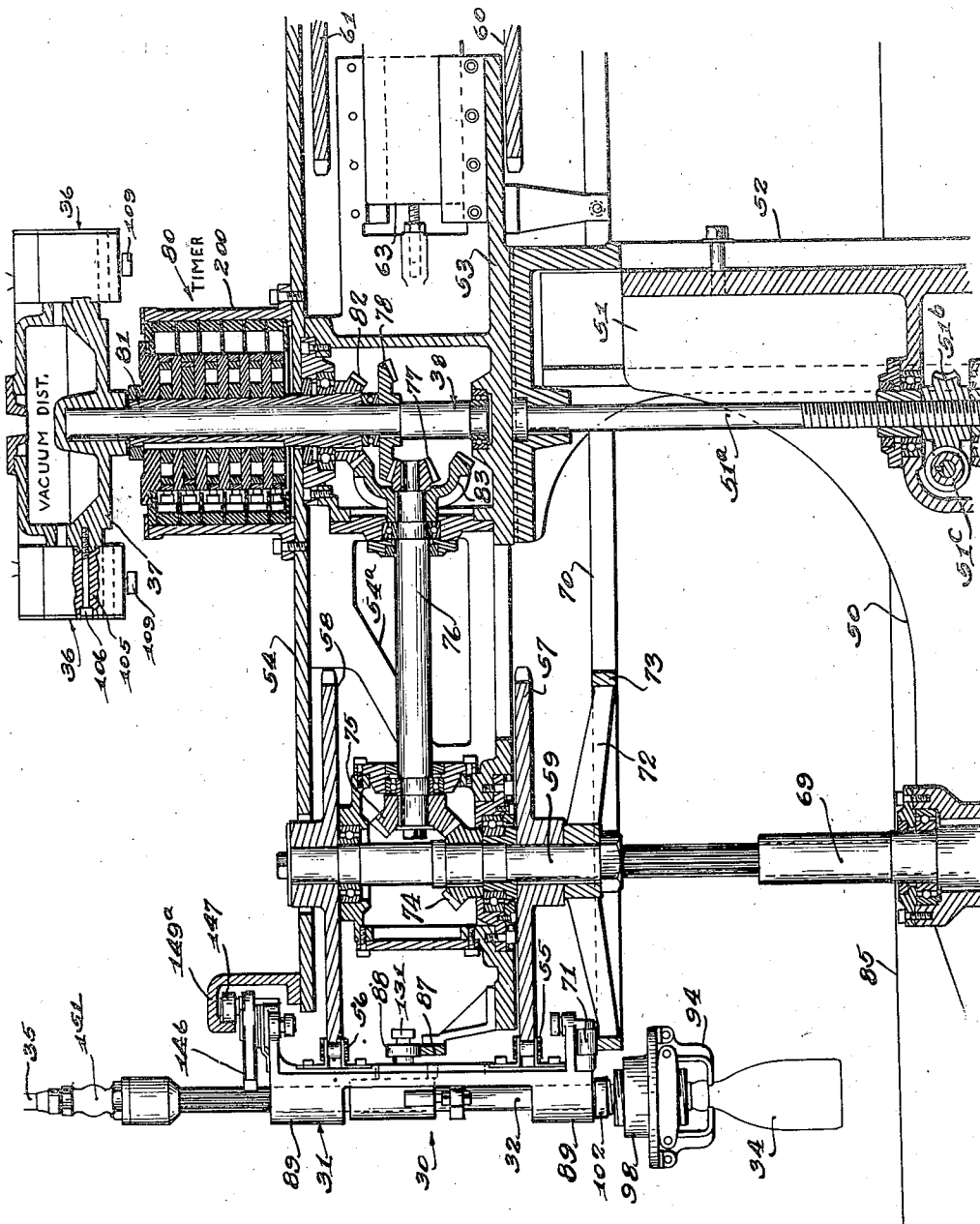


Fig. 8.

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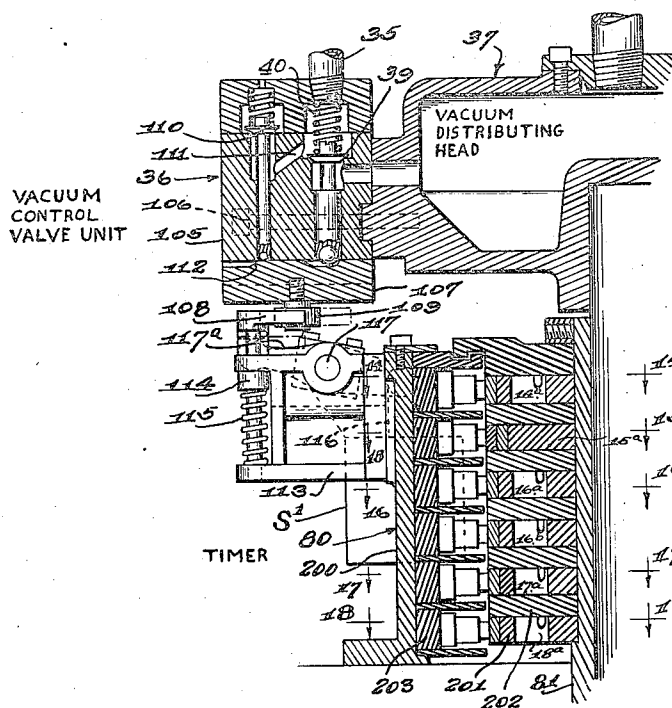


Fig. 9.

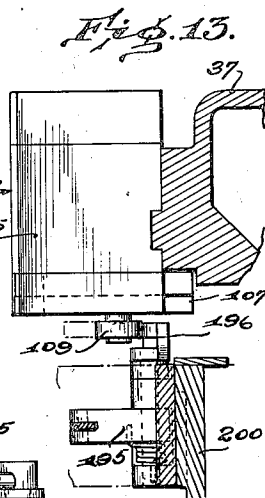


Fig. 13.

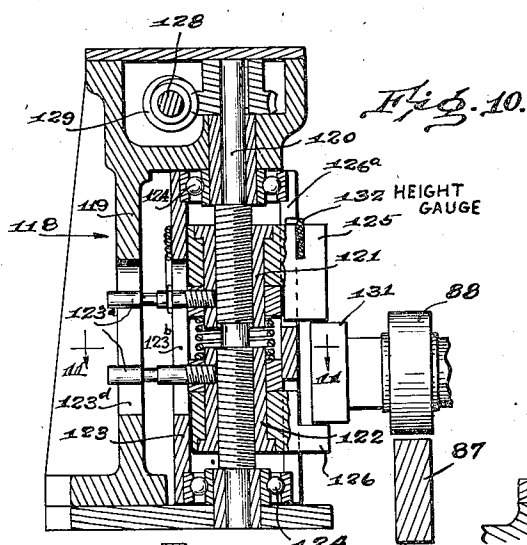
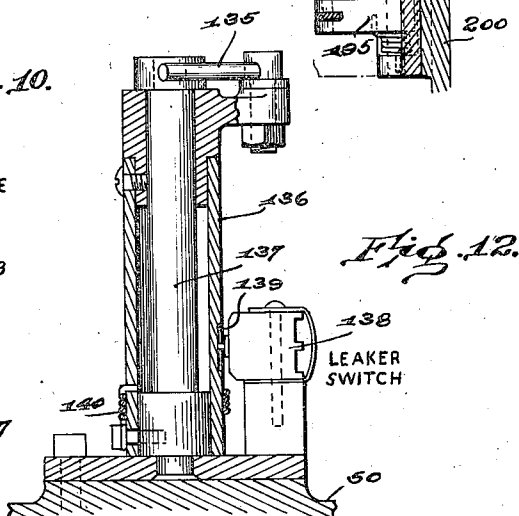


Fig. 10.



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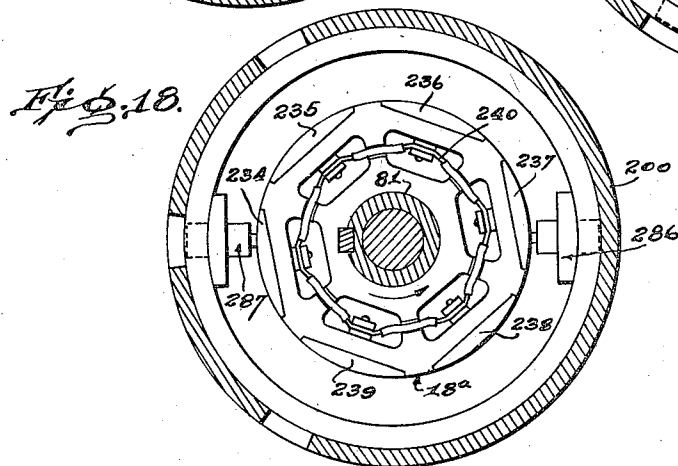
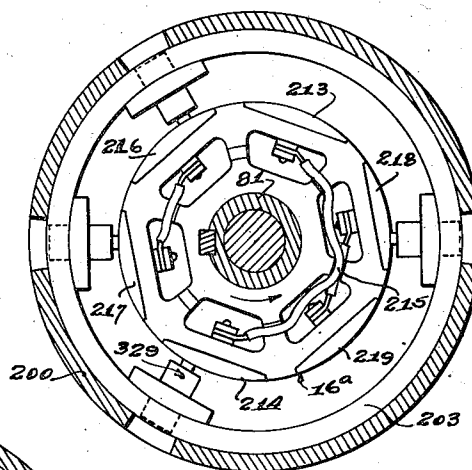
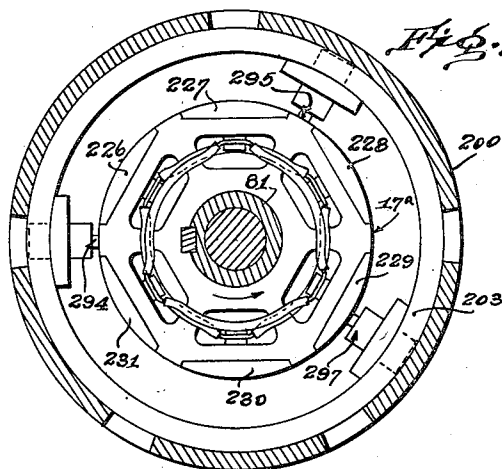
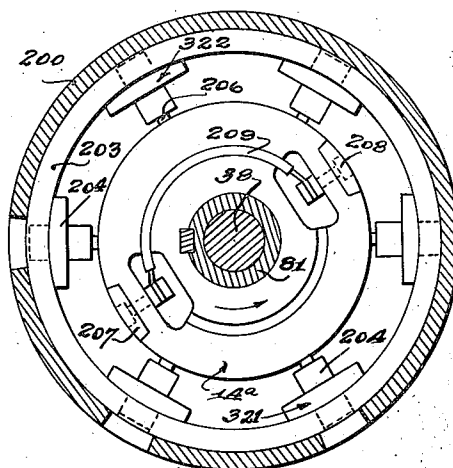
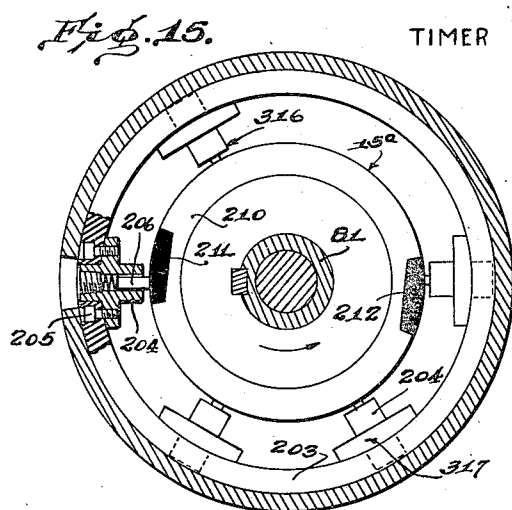
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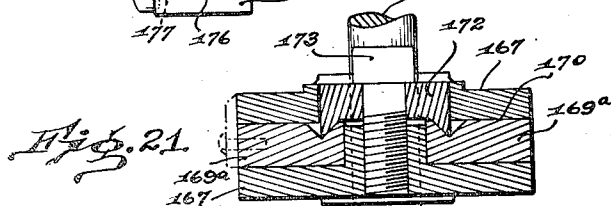
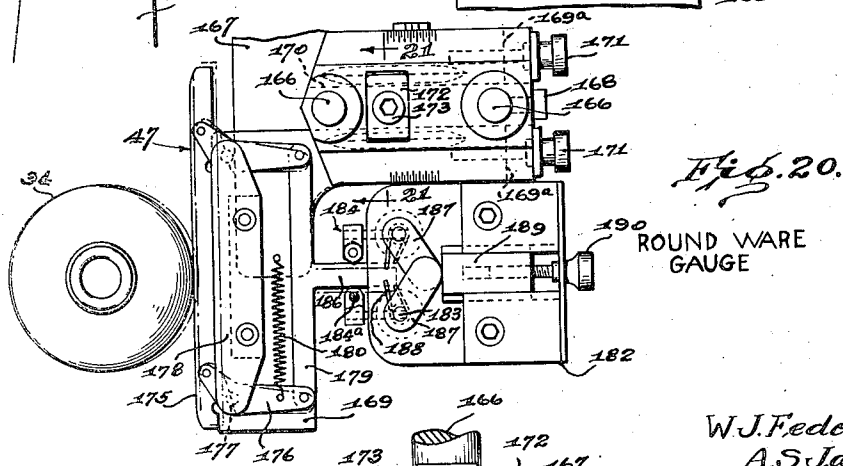
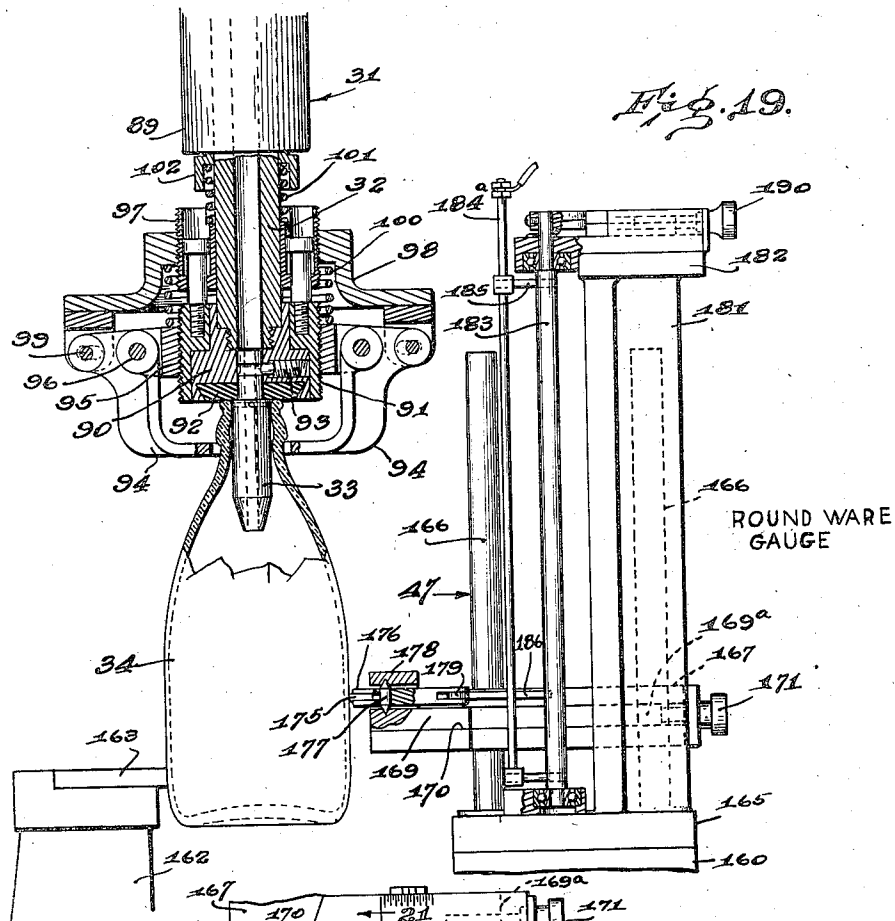
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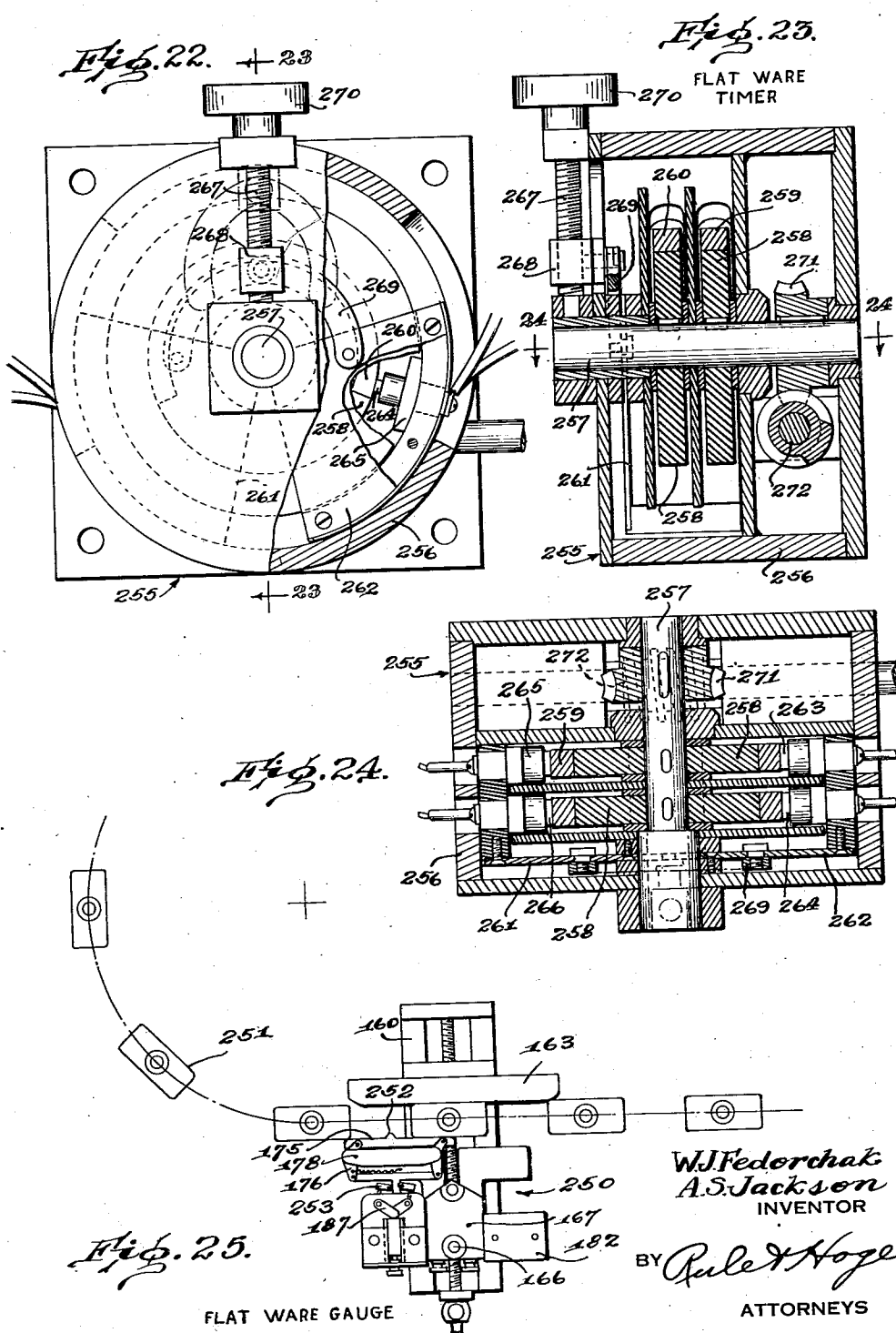
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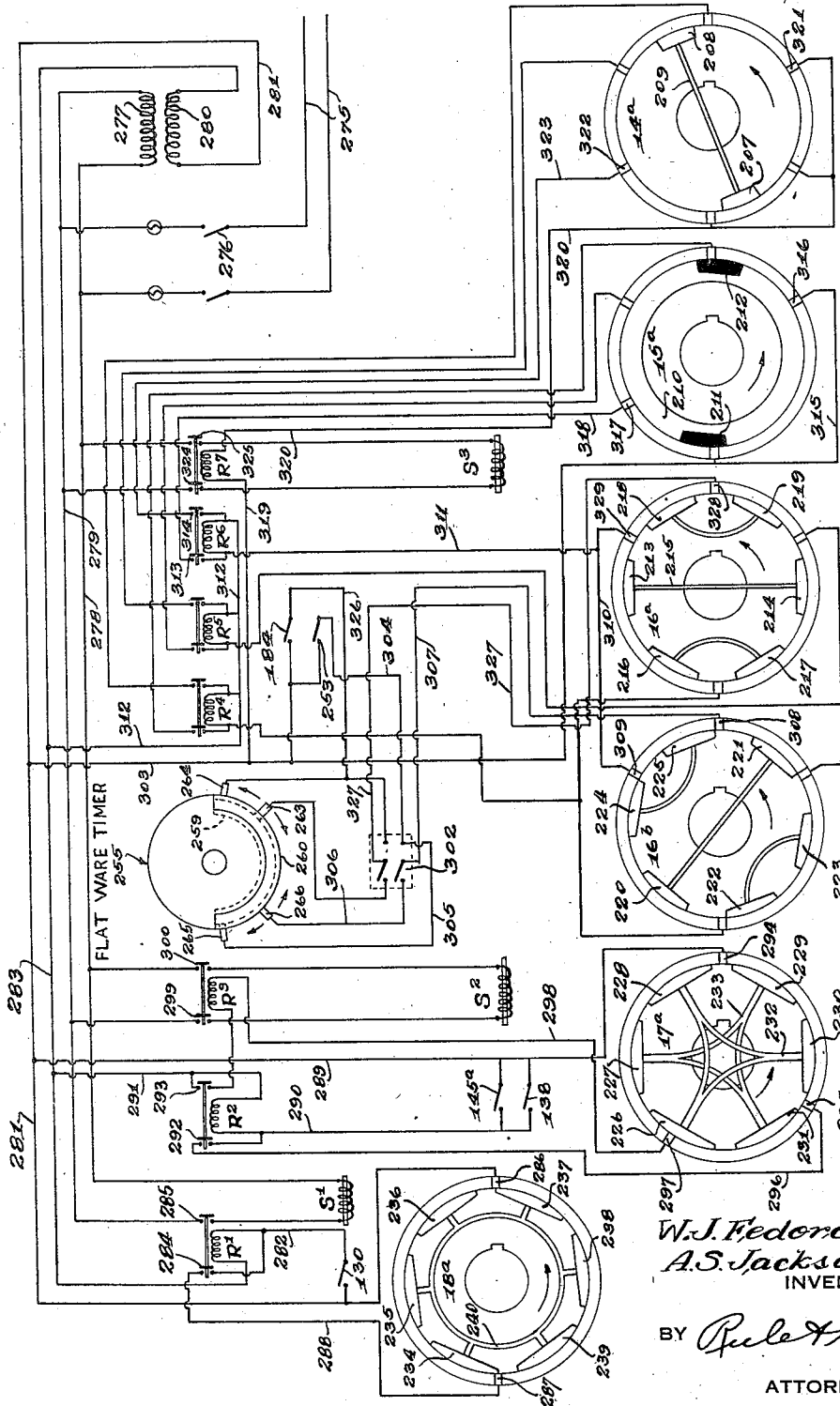


Fig. 26.

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UNITED STATES PATENT OFFICE

2,352,091

APPARATUS FOR GAUGING GLASSWARE

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Application February 5, 1941, Serial No. 377,468

30 Claims. (Cl. 209—88)

Our invention relates to apparatus for gauging bottles, jars and other glassware, testing them for a variety of imperfections, and automatically discarding defective ware. In the manufacture of glass bottles, jars and similar ware, it is practically impossible to produce uniformly perfect articles owing to the inherent nature of the glass which must be molded while in a hot plastic condition. While in such condition and during the gathering and blowing of the glass in the molds and the cooling, hardening and annealing processes, it is subject to many influences tending to distort the glass and introduce other imperfections.

At the present day it is the universal practice for trained inspectors, called selectors, to inspect the ware as it is taken from the annealing lehr, discarding those articles having imperfections which are detected visually as the articles are rapidly handled. Modern requirements for commercial ware are exacting as to size, shape, capacity, finish, etc. This is particularly true, for example, in regard to bottles which are to be filled and sealed by automatic machinery which does not permit of any material deviations in size, shape or finish of the bottles. Further, in the use of such automatic filling machinery, it is customary to introduce a filling tube or nozzle into the neck of the bottle and for satisfactory operation the interior of the bottle neck must be accurate as to size and shape.

A further defect which is frequently found in bottles and other glass containers relates to small leaks or pinhole openings through the glass, which may be the result of seeds or air bubbles embedded in the glass and breaking through the walls of the container. It is impossible by the usual methods of inspection to detect many of the defects by which the articles fail to meet standard requirements.

An object of our invention is to provide automatic gauging and testing apparatus which will register defects such as above noted and by which the bottles or other articles which are defective are automatically segregated and discarded. Such defective bottles include bottles either longer or shorter than the specified length, leaky bottles (called "leakers"), bottles with imperfect finish or imperfect neck openings, bottles out-of-round or otherwise irregular as to size or shape, bottles which lean ("leaners"), owing to rounded, irregular or defective bottoms, bottles with sunken or bulged sides, oversize and undersize bodies, bottles with mold seams or other irregularities and various other defects.

A further object of the invention is to provide an apparatus which is entirely automatic in its operation and which receives the bottles or other articles as they are discharged from the lehr and tests them in rapid succession, selecting and dis-

carding any defective articles, while those which stand the tests are conveyed to a packing table or other receiving means.

Other objects of the invention will appear hereinafter.

Referring to the accompanying drawings which illustrate a machine or apparatus for automatically gauging and testing bottles in accordance with the principles of our invention:

Figs. 1 and 2 are side elevations of the machine as viewed respectively from opposite sides of the machine.

Fig. 3 is a part sectional plan view of the same.

Fig. 4 is a fragmentary part-sectional plan view on a larger scale.

Fig. 4A is a detail view showing a micro-switch for controlling the vacuum valves when empty spindles are presented to the testing mechanism.

Fig. 5 is a sectional plan view of the apparatus, the section being taken substantially at the line 5—5 on Fig. 1.

Fig. 6 is a part-sectional plan view taken at the line 6—6 on Fig. 1.

Fig. 7 is a transverse sectional elevation at the line 7—7 on Fig. 3.

Fig. 8 is a longitudinal sectional elevation at the line 8—8 on Fig. 3.

Fig. 9 is a vertical sectional view showing a vacuum valve mechanism and the electric timer.

Fig. 10 is a vertical sectional view of the overall height gauge.

Fig. 11 is a section at the line 11—11 on Fig. 10.

Fig. 12 is a sectional elevation showing means for actuating an electric switch which controls the closing of the vacuum valves.

Fig. 13 is a sectional detail at the line 13—13 on Fig. 4 illustrating a vacuum valve closing means.

Figs. 14 to 18 inclusive are sectional plan views of the timer and distributing mechanism, the sections being taken at the correspondingly designated lines on Fig. 9.

Fig. 19 is a part-sectional elevation showing a bottle holding and gauging unit and also showing an "out-of-round" gauge.

Fig. 20 is a plan view of the "out-of-round" gauge.

Fig. 21 is a section at the line 21—21 on Fig. 20.

Fig. 22 is a part-sectional elevation of an electrical timer used in connection with a gauge for flat ware.

Fig. 23 is a section at the line 23—23 on Fig. 22.

Fig. 24 is a sectional plan view at the line 24—24 on Fig. 23.

Fig. 25 is a plan view showing a gauge for flat ware.

Fig. 26 is a wiring diagram of the electrical apparatus.

A brief description of the general construction and arrangement of the apparatus will now be

given, followed by a more detailed description. The apparatus comprises a series of gauging units 30 identical in construction, connected to form an endless chain and traveling continuously in a horizontal closed path spaced above a horizontal conveyor 85 on which the bottles are supported and travel with the gauging units. Each said unit 30 comprises a vertically disposed supporting bar or frame 31 (Figs. 8, 19) in which is journaled a lifting spindle 32 adapted for rotation and also for up and down movement in the frame 31. The spindles 32 are tubular and each carries at its lower end a nozzle 33 which serves as a filling tube gauge and is adapted to enter the mouth of a bottle 34 when the spindle is lowered and seats on the bottle. The plunger when thus seated seals the bottle, permitting suction to be applied through the nozzle for forming a partial vacuum within the bottle. The hollow spindles 32 are connected by flexible pipes 35 to an annular series of suction valve units 36 (Figs. 1, 3, 8, 9) individual to said spindles. The valve units are attached to a vacuum distributing head 37 mounted on a continuously rotating shaft 38. Each of the valve units 36 includes a suction or vacuum valve 39 (Fig. 9) which is opened automatically, as hereinafter described, whereby suction is applied to the bottle and a partial vacuum produced therein when the corresponding spindle has been lowered to seat on a bottle, providing the bottle is the correct height and the spindle properly positioned therein. As the gauging unit 30 advances, the spindle is lifted by a stationary can and the bottle, held thereon by suction, is also lifted and held in suspension.

If the overall length of the bottle is incorrect or does not come within the prescribed limits, the spindle when lowered onto the bottle will either be held thereby above normal position if the bottle is too tall or will be carried below normal position if the bottle is too short. In either event the travel of the spindle will cause it to operate a micro-switch controlling a solenoid S¹ (Figs. 4 and 9) which in turn operates to prevent the opening of the suction valve. Accordingly no suction will be applied to the bottle and therefore it will not be lifted with the spindle but will remain on the conveyor 85 and be carried thereby into the discard. If, on the other hand, vacuum has been produced and maintained in the bottle, it will be lifted and carried with the spindle for further tests.

If, for any reason, the lifting spindle when lowered onto a bottle fails to make a perfect seal owing, for example, to a defective finish, or if the bottle is not accurately aligned with the nozzle, owing to a "rocker bottom" bent neck or other deformity, or if the size or shape of the neck opening is incorrect, then the bottle will not be sealed to the lifting spindle and there will be no vacuum established within the bottle and it will not be lifted but will be discarded in the manner above noted.

After a bottle has been vacuumized, the vacuum valve is closed but the vacuum normally is retained within the sealed bottle. If a slow leak prevents the bottle from being held by suction until the test has been completed, it will drop off the spindle onto the conveyor 85 when the vacuum is dissipated and will thus be discarded. The bottles which have stood this test are carried with the spindles for a still further test.

A body gauge mechanism 47 (Figs. 5, 6, 19, 20),

herein referred to as an "out-of-round" gauge, is provided for testing round bottles to determine whether or not the bodies of the bottles are perfectly round and free from irregularities, bulges, high seams, etc., and of the correct size, and to discard any bottle that is defective in any of these respects. Such gauging mechanism also operates a micro-switch which controls means for opening the vacuum valve and releasing the defective bottle so that it is deflected by a switch 43 onto a conveyor 44 which delivers the defective ware to a table 45.

A more detailed description of the mechanism will now be given. The gauging apparatus as a whole is supported on a machine base 50 (Figs. 1, 2, 6, 7, 8) from which rises a standard 51. A frame member 52, channel-shaped in cross-section, embraces the standard 51 and is adjustable up and down thereon, for adjusting the gauging mechanism up and down to accommodate bottles of different heights. Adjusting means for this purpose includes a non-rotatable screw shaft 51^a (Fig. 8) fixed to frame member 52, a worm wheel 51^b threaded on the screw shaft, and a worm shaft 51^c to which is attached a hand crank 51^d (Fig. 2). The frame member 52 provides a rigid support for the framework in which driving mechanism for the chain of gauging units is mounted. Said framework includes a lower horizontal platform 53 or floor and an upper table or platform 54 united thereto by an integral web 54^a.

The vertical supporting bars 31 of the gauging units are connected by links to form endless sprocket chains 55 and 56 which are trained over lower and upper sprocket drive wheels 57 and 58 respectively (Fig. 8), said wheels being keyed to a drive shaft 59. The sprocket chains are also trained over driven sprocket wheels 60 and 61 (Figs. 5 and 8) mounted on a shaft 62, the latter journaled in a yoke 63. The yoke is formed with elongated slots 64 to receive clamping bolts 65 by which the yoke is bolted to the platform 54, said construction permitting adjustment to take up slack in the chains.

The driving mechanism comprises an electric motor 66 (Figs. 1 and 7) mounted in the machine base 50 and connected through a variable speed drive mechanism 67 and speed reduction gearing within a gear case 68 to a vertical drive shaft 69. The latter has a telescopic connection with the shaft section 59, permitting vertical adjustment of the framework 53, 54, carrying the gauging mechanism. The weight of the gauge unit frames 31 is carried by a horizontal track 70 (Figs. 1, 5, 8) on which run rolls 71 on the frames 31 while said frames are traveling in a straight line. Keyed to the shafts 59 and 62 for rotation therewith are rotary supporting members in the form of wheels 72, the peripheries 73 of which provide circular tracks onto which the rolls 71 run and by which the gauge frames 31 are supported as they travel in an arc about the axes of said shafts.

The vacuum distributor 37 (Fig. 8) in which a partial vacuum is continuously maintained, is driven from the shaft 59 through a train of gears comprising a bevel gear 74 keyed to the shaft 59 and meshing with a bevel gear 75 keyed to one end of a horizontal drive shaft 76, the other end of which carries a gear 77 in mesh with a gear 78 keyed to the vertical shaft 38. The timer mechanism 80 includes a series of rotary disks or members keyed to a tubular shaft 81 mounted for rotation on the shaft 38. A bevel gear 82 on the lower end of the shaft 81 is driven by a gear 83

keyed to the shaft 76. It will be noted that the gearing is proportioned to drive the timer at a higher angular speed than the shaft 38 and vacuum head. With the particular construction shown, the speed is so proportioned that the timer makes one complete rotation for every six gauging units coming under its control, the timer mechanism being designed to control six of the gauging units at a time. This greatly simplifies the mechanism and reduces the number of parts which would be required by a timer making one rotation for each cycle of the gauging units 30.

The bottles 34 which are to be gauged may be transferred directly from the annealing lehr to the gauging machine by means of the horizontal traveling conveyor 85 (Figs. 2 and 6). The bottles are correctly spaced and timed to be brought directly beneath and in register with the lifting spindles by means of a timer device 86^a and a star wheel 86. The parts 86, 86^a are driven from the gearing in the gear case 68, through a gear train including a shaft 86^b. When a bottle is brought beneath and in register with a spindle 32, the latter is lowered so that the nozzle 33 enters the neck of the bottle. The lifting and lowering movements of the spindle are controlled by a stationary track 87 (Figs. 1, 2, 5, 7, 8). Each spindle carries a roll 88 running on said track. The track includes dip sections 87^a (Fig. 2), 87^b and 87^c (Fig. 1) at a level below that of the main portion of the track, permitting the lifting spindles to be lowered as hereinafter described. As each bottle is brought beneath a spindle by the conveyor 85, the section 87^a of the cam track permits lowering of the spindle so that the nozzle 33 enters the bottle.

The construction of a gauging unit 30 will now be described, reference being had, for example, to Figs. 8 and 19. The supporting bar or frame 31 is formed with upper and lower bearing sleeves 89 in which the tubular spindle 32 is mounted for rotation and for vertical reciprocation. Attached to the lower end of the spindle is a head comprising an inner block or disk 90 surrounded by a sleeve 91 provided with exterior screw threads. The disk 90 carries a sealing pad 92 of rubber or other suitable material for seating on the lip of the bottle and forming a hermetic seal. The nozzle 33 is formed with a shank extending upwardly through the sealing pad and disk 90 and is secured within the latter by a set screw 93.

A pair of gripping jaws 94 are pivotally mounted on a supporting ring 95 threaded on the sleeve 91. The pivot pins 96 for the jaws are mounted in lugs formed on the ring 95. A sleeve 97 mounted to slide up and down on the spindle 32 has threaded thereon a cap 98 which has slot and pin connections 99 with the gripping jaws 94. It will be seen that with this construction, up and down movement of the cap 98 on the spindle will cause opening and closing movement of the jaws. A light coil spring 100 held under compression between the cap 98 and the ring 95 serves to hold the jaws 94 in open position while the spindle is lowered. A coil spring 101 is mounted on the spindle 32 above the sleeve 97. A collar 102 mounted on the spindle above the spring 101 and which may be attached to said spring is free to slide up and down on the spindle.

When the spindle 32 is lowered, the pad 92 seats on the neck of the bottle. Suction is then applied as hereinafter described to produce a partial vacuum within the bottle, so that when the spindle is raised, the bottle is lifted. The

jaws 94 are held open by the spring 100 while the spindle is in its lowered position. As the spindle approaches the limit of its upward movement, the collar 102 engages the lower bearing sleeve 89 of the bar 31 and operates through the spring 101 to arrest the upward movement of the sleeve 97 while the spindle continues its upward movement, so that the jaws are swung to closed position. The spring 101 being comparatively stiff, effects this closing movement before there is any substantial compression of the spring 101. The latter is compressed to a greater or less degree during the final upward movement of the spindle depending on the diameter of the bottle neck which determines the closed position of the jaws. The gripping jaws 94, although not always essential to the gauging operation, serve the important function of holding the bottle rigidly and preventing any side swing which might interfere with accurate gauging.

Referring to Figs. 8 and 9, each suction valve unit 36 includes a block 105 attached by bolts 106 to the vacuum distributing head 37. The vacuum valve 39 therein is closed by a spring 40 and is opened by means of a slide 107 mounted on the lower face of the block 105 for movement radially of the distributor head. The slide is actuated by means of cams including a valve opening cam 108 (Figs. 4 and 9) which projects into the path of a cam roll 109 on the slide. A relief valve 110 mounted in the block 105 is also actuated by the slide 107. The relief valve when lifted to its open position (Fig. 9) provides communication through a port 111 with the vacuum line above the valve 39 for venting the bottle and thereby dissipating the vacuum. The cam 112 (Fig. 9) for opening the relief valve 110 is so arranged that when the slide 107 is in its outermost position (Fig. 9) the relief valve is open and the suction valve 39 is closed. When the slide is moved to an intermediate position the relief valve is closed while the suction valve remains closed. When the slide is moved to the limit of its inward movement, the suction valve 39 is opened while the relief valve remains closed.

When a gauging unit 30 during its travel is brought to the dip section 87^a of the cam (Fig. 2) and lowered, the nozzle of said unit enters the bottle at position 34^a and the lifting spindle normally seats on and seals the bottle, assuming the bottle to be of the correct height. The cam 108 (Fig. 4) now engages the cam roll 109 individual to the bottle under test and moves the attached slide 107 inwardly, thereby opening the vacuum valve and applying suction to the bottle. Immediately or very shortly after the cam 108 has thus operated, a stationary cam 144 engages the cam roll and moves it outwardly to its intermediate position in which the suction valve 39 is closed while the relief valve remains closed, thereby leaving the bottle sealed with a partial vacuum therein. This permits the bottle to be tested for leaks and other imperfections as hereinafter described.

If, when the gauging unit 30 is lowered by the cam section 87^a, the lifting spindle is arrested either above or below the normal position, owing to the bottle being either longer or shorter than the specified length or if, for any other reason, the spindle is not brought to its normal lowered position, then the opening of the suction valve by the cam 108 is prevented. The preventing means includes a solenoid electromagnet S' (Figs. 4 and 9) which operates to withdraw the cam 108 downward out of the path of the cam roll.

The cam 108 is attached to the upper end of a frame 114 mounted for up and down sliding movement on a frame 113. Coil compression springs 115 normally hold the cam in its lifted position in the path of the cam rolls 109. When the solenoid is energized, its armature 116 is moved upwardly and rocks a shaft 117 which is journaled in the frame 113 and connected to the armature through a rock arm 116^a (Fig. 4). A second rock arm 117^a on said shaft engages the frame 114 and draws it downward when the solenoid is energized and the shaft 117 is rocked.

The solenoid S' is under the control of an overall height gauge 118 (Figs. 5, 10, 11). This gauge includes a stationary standard 119 in which is journaled a vertical shaft 120 formed with right and left-hand screw threads on which bushings 121 and 122 are threaded. A tubular shaft 123 having ball bearings 124 is mounted to oscillate about the axis of the shaft 120. Upper and lower contact blocks 125 and 126 journaled on the bushings 121 and 122 respectively are movable up and down therewith for adjusting said blocks toward and from each other. Said blocks extend through a slot 126^a in the tubular shaft 123 and provide a connection for rotating the shaft. Vertical adjustment of the contact blocks is effected by rotating the screw shaft 120 as by means of worm gearing including a hand operated worm shaft 128 and worm gear 129.

Each of the lifting spindles 32 carries a contact block 131 which, as it travels past the gauge 118, passes between the contact blocks 125 and 126 providing the bottle under test is the correct height and the lifting spindle is properly seated thereon. If the bottle is too tall, the block 131 will strike the upper contact block 125 and if the bottle is too short, it will strike the lower block 126. In either event the tubular shaft 123 is rotated against the tension of a light coil spring 132 which returns said shaft after the block 131 has passed the gauge. The rotation of the shaft 123 operates a micro-switch 130 (Fig. 11) which comprises a finger in engagement with a flat contact surface 130^a on the shaft 123. The micro-switch, as hereinafter described, controls a circuit for the solenoid S' (Fig. 9). In order to permit a backward rotary movement of the shaft 123 in the event that the machine is run backward manually for adjustment or other purpose, the following construction is provided (Figs. 10, 11). Arms 123^a are attached to the bushings 121 and 122 and extend radially outward therefrom through a slot 123^b in the shaft 123. Said arms are held by a coil tension spring 123^c against a bearing surface 123^d on the standard 118. This construction permits backward rotation of the shaft 123 if the machine is run backward and causes the block 131 to strike a contact block 125 or 126. Sufficient backward rotation of the shaft 123 is permitted to allow the block 131 to pass the gauge, said shaft being then returned by the spring 123^c.

If the height gauge 118 is operated as above described owing to the bottle under test not being the correct height so that the micro-switch 130 is operated, the solenoid S' operates in the manner above described and draws the cam 108 out of the path of the corresponding cam roll 109. The suction valve therefore remains closed and as a result there is no suction applied within the bottle under test. After a cam roll 109 has passed the cam 108, the corresponding lifting spindle is raised a short dis-

tance by a cam section 87^d (Fig. 2) which is at a somewhat higher level than the section 87^a and thereby lifts the bottle under test a short distance above the conveyor 85 providing the cam 108 has operated normally so that suction has been applied within the bottle. If, however, the solenoid has operated, owing to the bottle being of incorrect height or for other cause, so that no suction is applied, then the bottle remains on the conveyor and is carried thereby into the discard.

It sometimes happens that when the plunger has been lowered onto a bottle at position 34^a (Fig. 2) and the corresponding suction valve has been opened by the cam 108, the bottle may not be vacuumized. This may be due to failure of the pad 92 (Fig. 19) to make a perfect seal where the finish of the bottle is defective or may be due to some other irregularity or defect in the bottle. The plunger in this case also will fail to lift the bottle which will then be carried into the discard.

When a bottle successfully passes the test by the height gauge and is vacuumized so that the plunger succeeds in lifting the bottle, a test is applied for slow leakage. This test is dependent upon the operation of the stationary cam 144 (Fig. 4) to close the vacuum valve, sealing the bottle with a partial vacuum therein as heretofore described. If there is a slow leak due to any cause such as a pin hole opening, an imperfect bottle lip or other defect, the vacuum is gradually dissipated. As a result the bottle is released from the lifting spindle and drops onto the conveyor 85 by which it is carried into the discard.

If the bottle passes the above described tests as to height, slow leakage, etc., the corresponding vacuum valve 39 is again opened and suction applied and maintained while the bottle is carried by the spindle conveyor to the opposite side of the machine for a further test. The means for thus opening the vacuum valve comprises a cam 143 (Figs. 4 and 7) in the path of the cam rolls 109. If a bottle fails to pass the test so that it remains on the conveyor 85, it actuates means for rendering the cam 143 inoperative to open the vacuum valve for the spindle from which the defective bottle has been released. Such means includes a solenoid S², the electrical circuit of which is controlled by an arm 135 (Figs. 2, 6 and 12) extending over the conveyor 85 into the path of the bottles. This arm is carried on a tubular rock shaft 136 mounted to oscillate about a post 137. A micro-switch 138, herein referred to as a leaker switch, comprises a movable contact finger or operating element which engages a flat surface 139 formed on the shaft 136. Rotation of the shaft operates the micro-switch and thereby closes a relay circuit (as hereinafter described) controlling the solenoid S² (Figs. 4 and 7). The solenoid has operating connections with the cam 143 for lowering the latter when the solenoid is energized, said connections being of substantially the same construction as those between the solenoid S' and cam 108 as heretofore described. When the solenoid is energized its armature 141^a is moved upward and operates through a rock arm 141 and rock shaft 142 to lower the cam 143 out of the path of the cam rolls 109. The cam being thus lowered, the cam roll remains in its outer position as it passes the cam so that the associated vacuum valve 39 remains closed. This prevents dissipation of the vacuum from the system

through the empty spindle from which the defective bottle has been disengaged.

If an empty gauging unit or spindle passes the height gauge 118 it will cause the solenoid S' to operate in the same manner as an underheight bottle so that the cam 108 is withdrawn from the path of the cam roll 109 which controls the vacuum line for such empty spindle, and the valve slide retains its outer position with the suction valve closed. When the cam roll reaches the cam 143 it would be operated thereby to open the suction valve and thus open the vacuum system to the atmosphere through the empty lifting spindle, unless such cam operation were prevented. In this connection it will be noted that there is no bottle to operate the arm 135 for effecting an operation of the solenoid S². In order to prevent such opening of the vacuum system the following mechanism is provided. A micro-switch 145^a, herein referred to as an empty head switch, (Figs. 4 and 4A) is mounted on the cam 143 and comprises an operating pin 145^b projecting into the path of the cam rolls 109. The micro-switch 145^a controls a circuit for the solenoid S². When a cam roll corresponding to the empty spindle nears the cam 143 it engages the pin 145^b and actuates the micro-switch, thereby establishing a circuit for the solenoid S². This causes the solenoid to draw the cam 143 downward out of the path of the cam roll before the latter can be operated by the cam. Opening of the vacuum valve is thus prevented. Operation of the micro-switch 145^a by a cam roll when its vacuum valve is closed and the valve slide in its intermediate position (assumed when a vacuumized bottle is carried on the spindle) is prevented because the switch element 145^b does not project into the path in which the cam roll then travels.

While a vacuumized bottle is held in suspension by the spindle, it is gauged for body dimensions. Round bottles are gauged by the out-of-round gauging mechanism 47 (see Figs. 5 and 6). The bottle is rotated while it traverses the gauging mechanism which, as fully described hereinafter, includes twin gauging devices or units arranged one in advance of the other and each of which operates during the rotation of the bottle through 180°. This gauging mechanism is divided into two gauging devices in order to shorten the time required for the individual gauging operations when the distance between the adjoining spindles is insufficient to allow a complete rotation and gauging of each bottle by a single gauging device.

The means for rotating the bottles includes segmental racks 146 (Figs. 3, 4, 8) individual to the spindles, each rack having a pivotal mounting 148 on the upper end of the bar 31. A cam roll 147 on the segment runs in a cam track 149 (Fig. 3) formed on the under face of a stationary cam plate 150 while the bottle is traveling along the gauge 47. The cam track is so shaped that it rotates the segment 146 which runs in mesh with gear teeth formed on the upper portion of the spindle 32, thereby rotating the spindle and the bottle suspended thereby. A swivel joint 151 (Fig. 8) connects the tubular spindle with the pipe 35 and thereby permits such rotation. The cam roll 147 as it approaches the cam track 149 is guided along an arc-shaped track 149^a which holds the rack and spindle against rotation. A track 149^b at the opposite end of the spindle conveyor is arranged to guide the cam rolls in a path by which the racks 146 are rocked

in a reverse direction preliminary to a succeeding operation.

The body gauge or "out-of-round" gauging mechanism 47 (Figs. 1, 5, 6, 7, 19, 20, 21) is carried on a supporting frame 160 slidably mounted in guides 161 for adjusting the gauge toward and from the path of the bottles. A second frame 162 also slidably mounted in the guideways 161 carries a guide bar 163 in position to engage the bottles at the side opposite from the gauging mechanism, for supporting and guiding the bottles during the gauging operation. The slidable frames or members 160 and 162 are adjustable by means of a rod 164 having right and left hand screw-threaded engagement with said frames and rotatable by means of a hand crank 165^a.

The mechanism which is supported on the frame 160 includes a base plate 165 and a pair of posts 166 rising therefrom. Mounted on the posts and adjustable up and down thereon is a supporting frame 167. A clamping screw 168 (Fig. 20) holds the frame in its adjusted position. A pair of L-shaped supporting bars 169 carried by the frame 167 each includes an arm 169^a extending lengthwise of the frame 167 and slidably supported in guideways 170 in said frame. The bars 169 are adjustable toward and from the bottles by means of adjusting screws 171 having screw-threaded engagement with the arms 169^a and are held in adjusted position by a clamping block 172 (Figs. 20 and 21). The clamping block fits in an opening in the frame 167 and is clamped to the arms 169^a by a clamping bolt 173. Each of the supporting bars 169 carries a contact bar 175 adapted to engage a bottle while the latter is being tested. Each bar 175 is pivotally connected to the forward ends of a pair of bell crank levers 176 mounted on pivot pins 177, said pins having bearings in the bar 169 and a bar 178 spaced thereabove. A connecting rod 179 parallel with the contact bar 175 is pivotally connected to the opposite ends of the levers 176. The contact bar 175 is moved forward and held against the bottle which is under test by means of a coil spring 180.

Standards 181 rise from the base plate 165 and are formed at their upper ends each with a table 182. Associated with each table is a pair of vertical rock shafts 183 journaled with ball bearings at their upper ends in the table and at their lower ends in the base plate. A micro-switch 184 associated with the gauging mechanism includes a pair of vertical contact rods 184^a carried by rock arms 185 on the shafts 183, said rods being electrically insulated from said shafts. An arm 186 on the rod 179 extends between the rods 184^a, the latter being spaced to permit a small clearance between said arm and contact rods. Attached to the upper ends of the rock shafts 183 are rock arms 187. Springs 188 hold the free ends of the rock arms against a stop block 189 and thereby determine the position of the contact rods. The block 189 is adjustable by means of an adjusting screw 190 for adjustably varying the distance between the rods. While a bottle 34 is traversing the gauge, it rolls along the bar 175 which is held in contact therewith by the spring 180. If the bottle is of the specified diameter and perfectly round, the arm 186 will be held out of contact with the rods 184^a. If the bottle is of greater or less diameter than specified, the contact bar 175 will be moved either outwardly or inwardly and through the bell crank levers 176 will move the arm 186 into contact with one of the rods 184^a. This sets up a cir-

cuit controlling a solenoid S^3 (Fig. 4) which is operated later under the control of the timing mechanism as hereinafter described for causing the defective bottle to be discharged. Owing to the rotation of the bottle as it traverses the out-of-round gauge, the latter is operated also by bottles having any defects in the nature of a bulge in the side of the bottle, a sunken wall, a mold seam or similar defect or when the bottle is not perfectly round.

Referring to Figs. 1 and 6, a continuously traveling endless conveyor 191 below the path of the suspended bottles and moving in the same direction as the bottle carrying spindles, is in position to receive any bottle released from its spindle after passing the out-of-round gauge 47. A defective bottle is released to this conveyor on the left hand side of the switch or deflector 43 and directed thereby onto the conveyor 44, the latter being parallel with and traveling in the same direction as the conveyor 191. The defective bottle is deflected from the conveyor 44 by a deflector 192 onto the offware table 45.

Referring to Fig. 4, the electromagnet S^3 comprises an armature 194 connected to one arm of a bell crank lever 195. When the electromagnet is energized the armature is moved to the left and rocks the bell crank, bringing the other arm 196 thereof into the path of the cam rolls 109. A stationary cam 197 is arranged to move each cam roll 109 outward to its intermediate position for closing the corresponding vacuum valve shortly before such roll comes within the range of the arm 196.

Referring to Fig. 1, it will be noted that the bottles are held suspended by the lifting spindles while passing the gauge 47 and just after they have passed the gauge are lowered by means of the dip section 87^b. The cam 197 operates a cam roll 109 when the latter reaches the position 109^a (Fig. 4), the associated gauging unit 30 being at this time in the position 30^a. If the circuit for the solenoid S^3 has been set up by a defective bottle passing through the gauge 47, the solenoid is operated and moves the corresponding cam roll 109 outward about the time the bottle is lowered by the dip cam 87^b, thus closing the vacuum valve and venting the bottle so that it is released onto the conveyor 191 and discharged onto the offware table 45. If the bottle has passed the test of the gauge 47 it is again lifted by its spindle after passing the dip section 87^b and is thus carried over the deflector 43 and is then lowered onto the conveyor 191 by the dip section 87^c of the cam track.

A stationary cam 198 (Fig. 4) is positioned and arranged to move each cam roll 109 to its outermost position after the corresponding lifting spindle has passed the deflector 43 and is advancing along the dip section 87^c so that the vacuum valve is closed and the bottle vented to the atmosphere. This releases it from its lifting spindle, leaving the bottle on the conveyor 191 while the spindle is lifted as it moves off the dip section 87^c. The bottles which have thus passed all the tests are carried by the conveyor 191 to a packing station or to packaging mechanism by which they are packed in cartons.

The timer 80 by which the operations of the electrical control devices are timed and controlled is illustrated in Figs. 8, 9, and 14 to 18, and diagrammatically in Fig. 26. The timer includes a cylindrical casing 200 mounted on the platform 54 concentric with the tubular timer shaft 81 which extends upward therethrough. A

series of rotary contact carrying timer elements or disks are keyed to the shaft 81 and spaced by interposed spacing disks 202 of insulating material. The timer disks are designated respectively 14^a, 15^a, 16^a, 16^b, 17^a and 18^a. Cooperating with each timer disk is a stationary contact carrying ring 203 of insulating material mounted on the inner surface of the casing. The number of contacts carried by both the stationary and rotary elements varies. Each said stationary contact is mounted in a holder 204 (Fig. 15) attached by screws 205 to the ring. The contact 206 mounted therein is yieldingly held by a coil spring in engagement with the cooperating rotary disk and the contacts carried thereby. The rotary timer disk 14^a (Figs. 14 and 26) carries two diametrically opposite contacts 207 and 208 electrically connected by a wire 209. The timer disk 15^a carries a contact ring 210 of conducting material having diametrically opposite insulating blocks 211 and 212 inset in its periphery. The timer disk 16^a carries diametrically opposite contacts 213 and 214 connected by a conductor 215. It also carries two intermediate pairs of contacts, namely, electrically connected contacts 216 and 217, and electrically connected contacts 218 and 219. The timer disk 16^b and its contacts are a duplicate of those shown in Fig. 16, the contacts being numbered (Fig. 26) respectively 220, 221, 222, 223, 224 and 225. The contact disk 17^a carries six contacts uniformly spaced about its periphery, designated respectively 226, 227, 228, 229, 230 and 231. These contacts are electrically connected in two groups of three contacts each, the contacts 226, 228 and 230 being connected by a conductor 232 and the other contacts connected by a conductor 233. The timer disk 18^a carries six contacts 234, 235, 236, 237, 238 and 239, all electrically connected together by an annular conductor 240.

A flat ware body gauge 250 (Fig. 25) is used for gauging the bodies of bottles 251 or other ware having flat sides, or panelware. Either the gauge 250 or the gauge 47 may be used alternatively, depending on the shape of the articles being tested, the gauges being interchangeable and the same supporting base serving as a mounting for either gauge. The construction of the gauge 250 is in the main identical with that of the gauge 47 heretofore described except that one contact bar 175 and the switch mechanism operated thereby usually suffice for gauging the flat ware instead of two such contact bars and switch mechanisms as used with round bottles. The bar 175 (Fig. 25) is formed with a contact boss or point 252 which contacts with the flat side of the bottle while the latter is passing through the gauge. If the bottle is not of the specified thickness or presents any irregularities, the gauge operates a micro-switch 253 (Figs. 25 and 26) identical in construction and operation to the switch 184 heretofore described.

A flat ware timer 255 (Figs. 22, 23, 24, 26) is used in connection with the gauge 250 and in addition to the timer 80. The timer 255 controls a circuit for the switch 253 and determines the length of time said switch is operative while an article is passing through the gauge 250. It may be desired, for example, in testing panelware, to maintain a circuit for the switch 253 only while the contact 252 is traversing a panel or other defined surface portion of the bottle. By adjusting the timer the presently described gauging may be confined to such particular or defined section of the article.

Referring to Figs. 22 to 24, the timer 255 comprises a cylindrical casing 256 in which is journaled a continuously rotating shaft 257. Keyed to the shaft are two disks 258 having mounted on their peripheries arc-shaped electrical contact strips or shoes 259 and 260. Mounted for rotative adjustment about the axis of the shaft 257 are two sector shaped brush carriers 261 and 262. The sector 262 carries contact brushes 263 and 264 bearing respectively on the contact strips 259 and 260. The sector 261 carries brushes 265 and 266 engaging respectively the contacts 259 and 260. Means for adjusting the contact holders 261 and 262 comprises an adjusting screw 267 threaded through a nut 268 connected by a pair of links 269 to said holders. The screw 267 is rotated by a knob 270 for adjusting the segments and the brushes carried thereby and thereby adjustably varying the length of time the switch 253, controlled by the timer, is effective during the gauging operation. The timer shaft 257 and contacts carried thereby are rotated continuously, by the main motor connected thereto through a train of gearing including a worm gear 271 keyed to the timer shaft and a worm drive shaft 272. The timer shaft makes one complete rotation for each article or gauging unit passing through the gauge 250.

The electrical control system will now be described, reference being had to the wiring diagram (Fig. 26). The current may be taken from the mains 275 of a commercial line supplying, for example, a 60 cycle 110 volt current. A switch 276 in the main line controls the supply of current to the primary 277 of a step-down transformer. The solenoids S^1 , S^2 and S^3 are connected by main wires 278 and 279 in the primary circuit. The other control devices are connected in circuit with the secondary 280 of the transformer. These controls include relays R^1 , R^2 , R^3 , R^4 , R^5 , R^6 and R^7 .

The operation of the solenoid S^1 is, as heretofore described, under the control of the micro-switch 130 actuated by the height gauge. When said switch is tripped it closes a circuit through the relay coil R^1 , which circuit may be traced from the secondary of the transformer through wire 281, switch 130, wire 282, relay coil and wire 283, back to the transformer. The relay being thus energized operates contacts 284 and 285. Contact 285 closes a circuit through the solenoid S^1 . Closing of the contact 284 establishes a holding circuit for the relay R^1 through the timer disk 18^a. This circuit may be traced through conductor 281 and timer contacts 286, 237, conductor 240, contacts 234, 287, wire 288, contact 284, relay R^1 to main wire 283. This holding circuit is maintained until the timer contacts 237 and 234 pass the stationary contacts 286 and 287 and break the holding circuit so that the electromagnet S^1 is deenergized.

The solenoid S^2 is under the control of the leak switch 138 and the empty head switch 145^a. If either of said switches is tripped in the manner heretofore described, it makes a circuit through the relay R^2 by way of wires 289, 290 and 291. The relay being energized closes switch contacts 292 and 293. The contact 292 completes a holding circuit for the relay R^2 through the timer disk 17^a, the disk at this time being in such position that the contact 229 engages a stationary contact 294 while the contact 231 engages a contact 295. This holding circuit may be traced from main 281 through wire 289, contacts 294, 229, conductor 233, contacts 231, 295,

wire 296, contact 292, relay coil R^2 and wire 291. The relay R^3 remains deenergized for a short time after the relay R^2 is energized. A circuit for the relay R^3 is completed when the timer disk 17^a has advanced to a point at which the contact 227 engages a stationary contact 297. This circuit may be traced from the main 281 through wire 289, contacts 294 and 229, conductor 233, contacts 227, 297, wire 298, relay R^3 , contact 293, and wire 291. The relay R^3 being energized closes switch contacts 299 and 300, thereby completing a circuit for the solenoid S^2 .

If flat ware is being tested with the gauge 250 in use, the flat ware timer 255 is connected in the control circuit for the solenoid S^3 and operates in conjunction with the main timer mechanism. The timer 255 is connected in the circuit by throwing a double pole switch 302 to the left as shown in Fig. 26. If now a bottle or flask going through the gauge 250 trips the switch 253, owing to a defect in the ware, a circuit is closed through one of the three relays R^4 , R^5 , R^6 , whichever may have been brought into the tripping circuit by the timer disk 16^a. Assuming, for example, that the tripping of the switch 253 makes a circuit for the relay R^6 , such circuit may be traced from the main 281 through a wire 303, switch 253, wires 304, 305, timer contacts 265, 259, 260, 263, switch 302, wire 327, contacts 328, 219, 218, 329, wire 311, relay R^6 and wire 312 to main 283. The relay being energized closes its contacts 313 and 314. This establishes a holding circuit through the timer disk 15^a, which circuit is retained until the solenoid S^3 is energized and operates to discharge the defective bottle for delivery to the offware conveyor. The holding circuit for the relay R^6 may be traced through wires 303, 315, timer contacts 316, 210, 317, wire 318, relay contact 313, relay R^6 and wire 312. After the relay holding circuit has been established the timer disk 14^a operates at a predetermined time to make a circuit for the relay R^7 . This circuit may be followed through wires 303, 319, relay R^7 , wire 320, timer contacts 321, 207, conductor 209, contacts 208, 322, wire 323, relay contact 314, and wire 312. The relay R^7 being thus energized closes contacts 324 and 325 and thereby completes a circuit for the solenoid S^3 . The solenoid operates as heretofore described to effect a discharge of the defective bottle.

For round ware gauging the flat ware timer 255 is cut out of circuit by throwing the switch 302 to the right. When a defective bottle passing through the body gauge 47 operates to trip the switch 184, a circuit is made for one of the relays R^4 , R^5 , R^6 , independent of the timer 255. For example, the circuit may again be traced through the timer R^6 , such circuit being through wire 303, switch 184, wire 326, switch 302, wire 327, timer contacts 328, 219, 218, 329, wire 311, relay R^6 , wire 312. The relay R^6 being energized operates as before to establish a holding circuit which permits the timer disk 14^a at a predetermined time to energize the relay R^7 and effect the operation of solenoid S^3 . The circuits for the relays R^4 and R^5 may be readily traced in the same manner as the circuit for relay R^6 when the timer disks 16^a or 16^b are in position to establish such circuits.

Modifications may be resorted to within the spirit and scope of our invention.

We claim:

1. Apparatus for gauging the height of bottles or other articles, comprising a horizontally trav-

eling conveyor on which the articles are supported, article lifting devices, means for supporting said lifting devices above the conveyor and causing them to travel with the conveyor, means for lowering the lifting devices and causing them to seat on the articles and travel therewith, a stationary gauge comprising a contact element, cooperating contact blocks carried by said lifting devices at a height predetermined by the height of said articles, said traveling contact blocks being arranged to clear the contact element on the gauge when the corresponding articles are of a specified height and arranged to engage said contact element on the gauge when the articles are of a different height and thereby actuate the gauge, and means controlled by the gauge for discarding said last mentioned articles.

2. Apparatus for testing round bottles or other round articles, comprising a series of article holders, an endless carrier to which said holders are connected, means for driving said carrier, means for attaching the articles to said holders, a gauge comprising a contact bar positioned to engage the sides of the articles, means for rotating said holders and the articles carried thereby and causing the latter to roll along the contact bar, and electro-responsive means actuated by movements of said bar for determining articles deviating from a specified diameter or shape.

3. Apparatus for testing round bottles or other round articles, comprising a series of article holders, an endless carrier to which said holders are connected, means for driving said carrier, means for attaching the articles to said holders, a gauge comprising a contact bar positioned to engage the sides of the articles, means for rotating said holders and the articles carried thereby and causing the latter to roll along the contact bar, and electro-responsive means actuated by movement of the bar to release the articles from their holders.

4. Apparatus for testing round bottles or other round articles, comprising a series of article holders, an endless carrier to which said holders are connected, means for driving said carrier, means for attaching the articles to said holders, a gauge comprising a contact bar positioned to engage the sides of the articles, means for rotating said holders and the articles carried thereby and causing the latter to roll along the contact bar, electro-responsive means actuated by movement of the bar to release the articles from their holders, a conveyor positioned beneath the path of the article holders beyond the gauge, a deflector positioned beyond the gauge, automatic means for releasing articles after they have passed the deflector and delivering them to said conveyor, and electro-responsive means for causing the release of defective articles before reaching the deflector and thereby segregating them from the other articles.

5. Apparatus for gauging round articles, comprising article holding spindles, a contact bar having a stationary mounting, a carrier for the spindles, means for driving the carrier and causing the articles held by the spindles to move in succession along said contact bar with the latter in engagement with the round surface of the article, means for rotating said spindles and thereby rotating the articles as they move along the contact bar, electro-responsive means actuated by said bar, and mechanism controlled by said electro-responsive means for segregating defective articles from the others.

6. Apparatus for gauging round articles, com-

prising a series of article holding spindles, an endless carrier for the spindles, means for driving said carrier and causing the spindles to travel in a closed path, a stationary gauge comprising a contact bar positioned to contact with the round bodies of the traveling articles, and means for rotating said spindles and causing the articles to rotate as they advance along said contact bar.

10 7. Apparatus for gauging round articles, comprising a series of article holding spindles, an endless carrier for the spindles, means for driving said carrier and causing the spindles to travel in a closed path, gauging mechanism, 15 comprising a plurality of contact bars arranged one in advance of the other adjacent the path of travel of the articles under test, means for holding said bars in contact with the articles while the latter move along the bars, means for rotating the articles and causing rolling contact 20 thereof with said bars, and electro-responsive means actuated by said bars, and mechanism controlled by said electro-responsive means for segregating defective articles from those of 25 specified size and shape.

8. Apparatus for gauging hollow articles, comprising a supporting spindle, means for engaging said spindle with an article to be tested, means comprising a vacuum line leading to the 30 article for applying suction within the article and thereby vacuumizing the article and causing it to be held by the spindle, a valve in the vacuum line, a gauge comprising a contact bar, means for moving the spindle with the article held thereby and causing the latter to move along the 35 contact bar, and automatic means actuated by said bar for opening said valve, breaking the vacuum and releasing the article.

9. Apparatus for gauging hollow articles, comprising a supporting spindle, means for engaging said spindle with an article to be tested, means comprising a vacuum line leading to the 40 article for applying suction within the article and thereby vacuumizing the article and causing it to be held by the spindle, a valve in the vacuum line, a gauge comprising a contact bar, means for moving the spindle with the article 45 held thereby and causing the latter to move along the contact bar, an electro-responsive device actuated by said contact bar when the latter is actuated by a defective article, an electromagnet controlled by said electro-responsive device, and operating connections between the electro- 50 magnet and the valve for opening the latter when the electromagnet is energized and thereby venting the article and causing its release from said spindle.

10. A machine for gauging bottles or other articles, comprising a drive shaft, means for rotating it, a vacuum chamber, an annular series 60 of valve casings mounted to rotate with said shaft, a spindle carrier, spindles carried thereby, means for driving said carrier in a closed path surrounding the axis of said shaft and in synchronism with the rotation of said valve casings, means providing vacuum lines extending 65 from the vacuum chamber through said valve casings and to said spindles, valves mounted within said casings and providing means between the vacuum chamber and spindles for opening and closing said vacuum lines, means for engaging articles to be tested with said spindles and causing them to be held thereon by suction applied through the vacuum lines, a gauge 70 for gauging said articles, means for actuating

said valves, and means controlled by the gauge for rendering the valve actuating means ineffective.

11. A machine for gauging bottles or other articles, comprising a drive shaft, means for rotating it, a vacuum chamber, an annular series of valve casings mounted to rotate with said shaft, a spindle carrier, spindles carried thereby, means for driving said carrier in a closed path surrounding the axis of said shaft and in synchronism with the rotation of said valve casings, suction valves mounted in said casings, means providing vacuum lines extending from the vacuum chamber to said spindles, valves in said casings controlling said vacuum lines, means for engaging articles to be tested with said spindles and causing them to be held thereon by suction applied through the vacuum lines, a gauge for gauging said articles, a cam, valve operating devices carried on said valve casings and arranged to be operated by said cam, and automatic means controlled by the gauge for rendering said cam ineffective to operate said valve operating devices.

12. A machine for gauging bottles or other articles, comprising a drive shaft, means for rotating it, a vacuum chamber, an annular series of valve casings mounted to rotate with said shaft, a spindle carrier, spindles carried thereby, means for driving said carrier in a closed path surrounding the axis of said shaft and in synchronism with the rotation of said valve casings, suction valves mounted in said casings, means providing vacuum lines extending from the vacuum chamber to said spindles, valves in said casings controlling said vacuum lines, means for engaging articles to be tested with said spindles and causing them to be held thereon by suction applied through the vacuum lines, a gauge for gauging said articles, valve operating slides mounted on said valve casings, cam rolls carried thereby, a stationary cam in the path of said cam rolls and operable to move said slides in succession, an electromagnet, operating connections between the magnet and the cam for withdrawing the latter to an inoperative position, and electro-responsive means actuated by said gauge for establishing an operating circuit for the electromagnet.

13. Apparatus for gauging bottles, comprising a drive shaft, means for rotating it, an endless carrier, driving connections between the carrier and shaft for continuously driving said carrier in a closed path, lifting spindles carried on said carrier, a vacuum chamber, an annular series of valve casings mounted to rotate with said shaft, means providing vacuum lines extending from said chamber through said casings to said spindles, vacuum valves mounted in said casings and controlling said vacuum lines, means for attaching bottles to the spindles and causing them to be vacuumized by suction through said vacuum lines, a stationary gauge in the path of the bottles carried by said spindles, and means actuated by said gauge for controlling the operation of said vacuum valves.

14. Apparatus for gauging bottles, comprising a drive shaft, means for rotating it, an endless carrier, driving connections between the carrier and shaft for continuously driving said carrier in a closed path, lifting spindles carried on said carrier, a vacuum chamber, an annular series of valve casings mounted to rotate with said shaft, means providing vacuum lines extending from said chamber through said casings to said

spindles, vacuum valves mounted in said casings and controlling said vacuum lines, means for attaching bottles to the spindles and causing them to be vacuumized by suction through said vacuum lines, a stationary gauge in the path of the bottles carried by said spindles, valve slides mounted on said casings, a stationary cam operable to move said slides in succession, an electromagnet, means actuated by said gauge to energize the electromagnet, and means actuated by the electromagnet to control said operation of the valve slides.

15. Bottle gauging apparatus, comprising a carrier, bottle holding spindles thereon, means for driving the carrier, a stationary gauge arranged to gauge said bottles in succession as they travel with the carrier, means for releasing the bottles from said spindles, an electromagnet, means operated thereby to render said releasing means inoperative, electro-responsive means actuated by the gauge, a relay controlled by said electro-responsive means, a timer driven in synchronism with said carrier and controlling a circuit for said relay, and means actuated by the relay for controlling the operation of the electromagnet.

16. Apparatus for gauging the height of articles, comprising a support, a lifting device positioned above the support and movable up and down relative to said support, said lifting device being adapted when lowered to engage the upper end of an article standing on said support and to be arrested thereby, holding means for effecting a holding engagement between the lifting device and the article after the lifting device has been arrested by the article, when the latter is of a specified height and causing the article to be lifted with the lifting device, and automatic means brought into activity after the lifting device has been lowered and while in said arrested position, to prevent said operation of the holding means when the lifting device has been arrested in a position above or below that determined by an article of a specified height.

17. Apparatus for gauging the height of articles, comprising a support for the articles, a lifting device positioned above said support, automatic means for moving said lifting device downward into contact with an article positioned on said support and thereby arresting said device at a position determined by the height of the said article and thereafter lifting said device, automatic holding means brought into operation while the lifting device is in said arrested position for effecting a holding engagement between the lifting device and the article and for causing the latter to be lifted with said lifting device, and automatic mechanism to render said holding means ineffective when the position at which the lifting device is arrested is above or below that determined by an article of a specified height.

18. Apparatus for gauging the height of articles, comprising a support, a lifting device positioned above the support and movable up and down relative to said support, said lifting device being adapted when lowered to engage the upper end of an article standing on said support and to be arrested thereby, suction holding means for effecting a holding engagement between the lifting device and the article after the lifting device has been arrested by the article, when the latter is of a specified height and causing the article to be lifted with the lifting

device, and automatic means brought into activity after the lifting device has been lowered and while in said arrested position, to prevent said operation of the holding means when the lifting device has been arrested in a position above or below that determined by an article of a specified height.

19. Apparatus for gauging the height of articles, comprising a support, a lifting device positioned above the support and movable up and down relative to said support, said lifting device being adapted when lowered to engage the upper end of an article standing on said support and to be arrested thereby, suction holding means for effecting a holding engagement between the lifting device and the article after the lifting device has been arrested by the article, when the latter is of a specified height and causing the article to be lifted with the lifting device, and electroresponsive means controlling said suction means and operable automatically while said lifting device is in said arrested position to prevent operation of the suction means if said lifting device is either above or below a predetermined height when in said arrested position.

20. Apparatus for gauging a hollow article, comprising a support for the article, a plunger, means for moving the plunger toward and from said support for engaging the article while the latter is on said support, and causing the plunger to be arrested at a position determined by the length of the article, means brought into activity a time interval after the plunger is arrested, for applying suction through the plunger and thereby attaching the article thereto when the article is of a specified length and automatic means brought into operation during said time interval for rendering said suction means ineffective when the length of the article is greater or less than said specified length.

21. Apparatus for gauging a hollow article, comprising a support for the article, a plunger, means for moving the plunger toward and from said support for engaging the article while the latter is on said support, and causing the plunger to be arrested at a position determined by the length of the article, means brought into activity a time interval after the plunger is arrested, for applying suction through the plunger and thereby attaching the article thereto when the article is of a specified length, and electroresponsive means automatically brought into activity during said time interval and controlled by said arrested position of the plunger for rendering said suction means ineffective when the plunger is arrested before it has reached or after it has passed a normal position determined by an article of said specified length.

22. Article gauging apparatus comprising a traveling support for articles to be tested, a lifting device positioned above said support, means for causing the lifting device to travel with said support, means for lowering said lifting device into engagement with the upper end of an article upon said support and causing it to be arrested by the article at a height determined by the length of the article and thereafter lifting said device, means brought into operation automatically a time interval after the lifting device is arrested, to effect a holding engagement between the lifting device and the article, so that the latter is lifted by said lifting device when the article is of a specified length, and automatic means to prevent said holding engagement when the holding device is held by the article above or below a

normal position determined by an article of specified length.

23. A gauging apparatus comprising a horizontally traveling conveyor, lifting devices, a carrier for said lifting devices spaced above said conveyor, means for causing said carrier to travel with the conveyor, means for lowering said lifting devices into contact with the upper ends of articles carried on the conveyor and causing the lifting devices to be arrested by the articles in lowered positions determined by the height of the articles, automatic means brought into activity a time interval after the lifting devices have been arrested and while in said lowered positions, for causing them to grip the articles when the latter are of a specified height, and automatic means to prevent operation of the gripping means when said devices are held by the articles, either above or below a position determined by an article of specified height.

24. Apparatus for testing the length of bottles or other articles, comprising a horizontally traveling belt conveyor providing a bottom support on which the articles are supported in upright position, a stationary gauging mechanism, a device spaced above the articles, means for moving said device downward and causing it to seat on said articles and be held thereby at a height determined by the length of the articles and to travel at said height with the articles past said gauging mechanism, said device being arranged to clear the gauging mechanism when held at a normal height by an article of specified length and operable to actuate said gauging mechanism when held at a different height, and means controlled by said gauging mechanism to segregate from the articles of said specified length, the articles of a different length.

25. Gauging apparatus for gauging flat articles, comprising a traveling carrier, means for connecting the articles to the carrier to travel therewith and for holding the articles in predetermined positions relative to the carrier, a contact element positioned at the path of travel of the articles and arranged to contact a flat surface of each article as the latter moves therealong, said contact element being mounted for movement transversely of said path, means for holding said contact with a yielding pressure against said surface whereby movement of the contact element is caused by irregularities in said surface, electro-responsive means operable while a predetermined portion of each said flat surface is in contact with said element, said electro-responsive means including a switch arranged to be operated by said movement of the contact element, a timer comprising electrical contact devices in circuit with said electro-responsive means, mechanism for rotating the timer in synchronism with the traveling movements of said carrier and causing it to make and break a circuit through said electro-responsive means when the traveling carrier and the article under test reach predetermined points during the travel of the article along the said contact element, and adjusting mechanism for adjusting said timer contact devices and thereby adjusting said points for rendering the gauging apparatus operable along adjustably variable surface portions of the articles under test.

26. Apparatus for gauging the height of articles, comprising a horizontally traveling conveyor forming a support for articles to be tested, a series of lifting spindles, an endless carrier on which said spindles are mounted, means for driv-

ing said carrier and conveyor in the same direction and at the same speed and causing the lifting spindles to travel in a horizontal path above and parallel with said conveyor, means for lowering each spindle at a predetermined point during its said travel and causing it to seat on a said article and travel therewith, with the spindle supported at a height corresponding to and determined by the length of the article, holding means individual to the spindles and operable automatically to effect holding engagement between a said article and the spindle seated thereon, and automatic control means to render said holding means inoperative when the length of an article is either greater or lesser than a specified length, said control means comprising a contact device having a stationary mounting, and cooperating contact means carried with the spindle at a height determined by the length of the article on which the spindle is mounted.

27. Apparatus for gauging the height of articles, comprising a horizontally traveling conveyor forming a support for articles to be tested, a series of lifting spindles, an endless carrier on which said spindles are mounted, means for driving said carrier and conveyor in the same direction and at the same speed and causing the lifting spindles to travel in a horizontal path above and parallel with said conveyor, means for lowering each spindle at a predetermined point during its said travel and causing it to seat on a said article and travel therewith, with the spindle supported at a height corresponding to and determined by the length of the article, suction means for effecting a holding engagement between the article and the spindle a time interval after the latter is seated on the article, and electro-responsive means automatically brought into activity during said time interval for rendering said suction means inoperative when an article holds a lifting device above or below the normal position determined by an article of specified length.

28. Apparatus for gauging the height of bottles or similar articles, comprising a traveling conveyor on which the articles are supported, lifting spindles, an endless carrier on which the spindles are mounted, means for driving the carrier in the same direction at the same speed as said conveyor and causing the spindles to travel in a path above and parallel with said conveyor, means for lowering the spindles into engagement with the articles, automatic means for causing the spindles to grip the articles at a time interval after the spindles are lowered when the articles are of a specified height, means for lifting said spindles and the articles carried thereby, automatic means brought into activity during said time interval for preventing articles from

being lifted with the spindles when either above or below a specified height, said preventing means including contact devices connected to travel with the spindles at a height determined by the height of the said articles, and a cooperating contact positioned to pass between the said traveling contact devices when the latter are at a predetermined height, and to be engaged by one of said traveling contact devices when the latter are above or below said height.

29. Apparatus for testing bottles or like articles, comprising a horizontally traveling conveyor on which the articles are supported, a horizontally traveling spindle above the conveyor, means for causing the spindle and conveyor to travel in the same direction and at the same speed, means for lowering the spindle while traveling with the conveyor and causing it to seat on a said article, means for vacuumizing the article and causing a sealing engagement thereof with the spindle, and electro-responsive means for rendering the vacuumizing means ineffective when the spindle in its lowered position is above or below the specified level determined by the specified height for the article under test, said electro-responsive means including a contact device connected to the spindle to travel therewith at a height determined by the height of the spindle while the latter is traveling in its lowered position, and cooperating contact means in a position in which it is out of the path of said traveling contact device when the spindle is traveling at said specified level, and in the path of said traveling contact device when the spindle is above or below said level.

30. Bottle gauging apparatus comprising a series of bottle carrying devices, holding means for securing the bottles to and suspending them from said carrying devices, a gauge, means for causing the bottles to be tested in succession by said gauge, the latter comprising a contact element movable to a position determined by the contour of the bottle under test, a switch operable by said contact element, a timer, means for driving the timer in synchronism with the movements of the said carrying devices, a relay including a coil in circuit with said switch and a contact actuated thereby to establish a holding circuit through the timer, an electromagnet, means operable thereby to render said bottle holding and suspending means ineffective, and a circuit for the electromagnet including a contact actuated by said relay, said circuit being established by and extending through said timer when the latter reaches a predetermined position.

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