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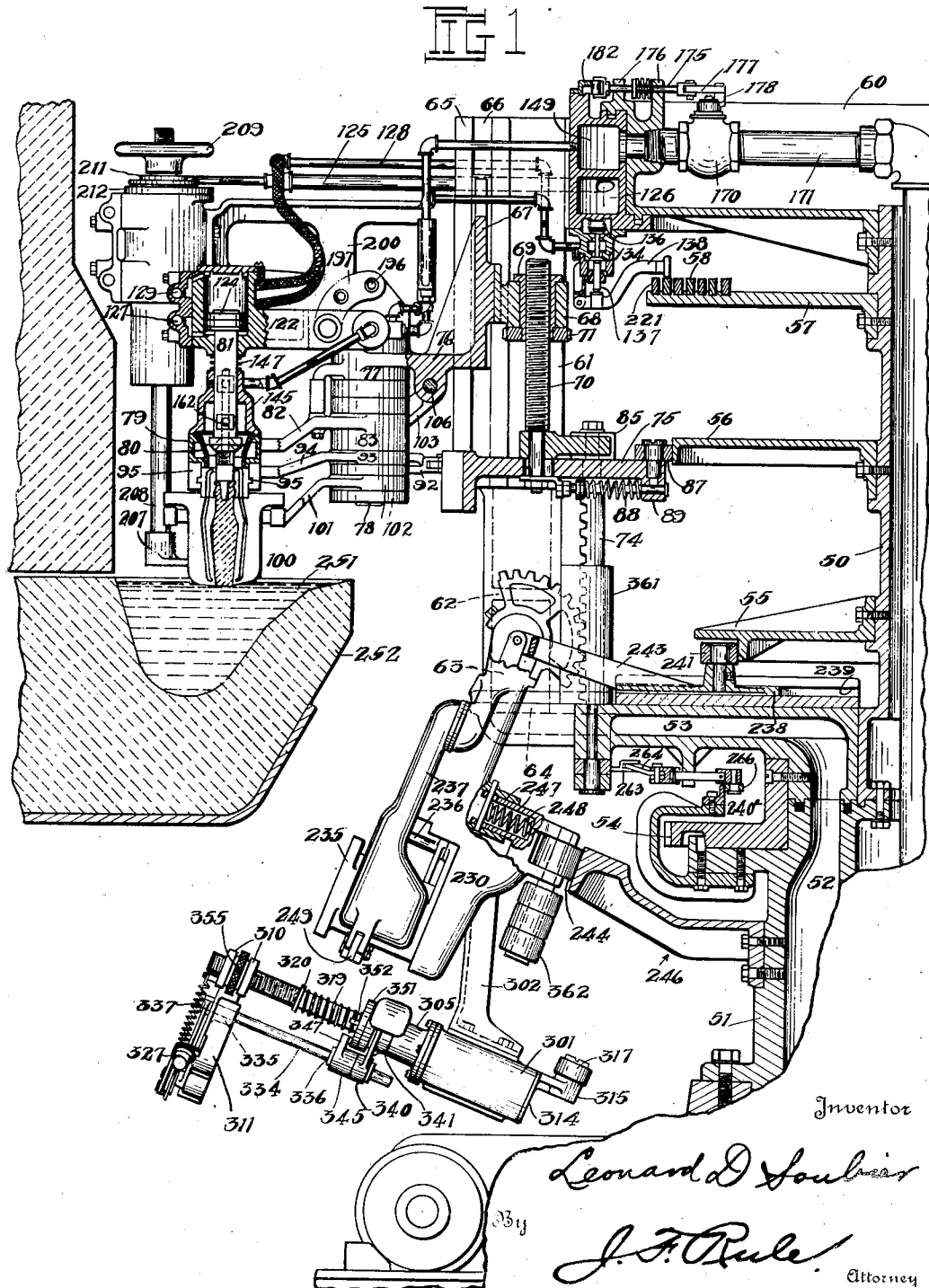
L. D. SOUBIER

1,976,583

GLASSWARE FORMING MACHINE

Original Filed Jan. 3, 1928

13 Sheets-Sheet 1



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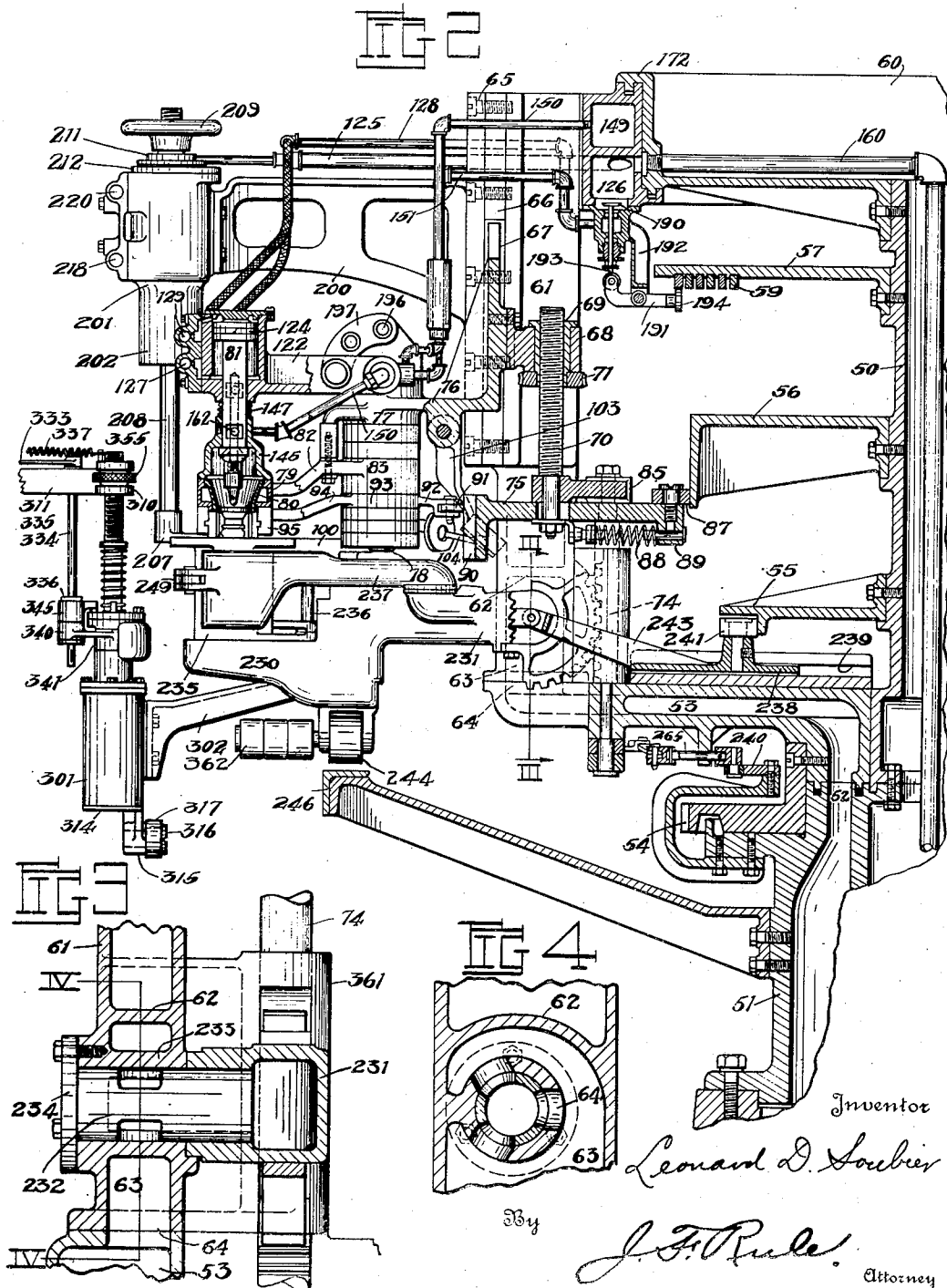
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GLASSWARE FORMING MACHINE

Original Filed Jan. 3, 1928

13 Sheets-Sheet 2



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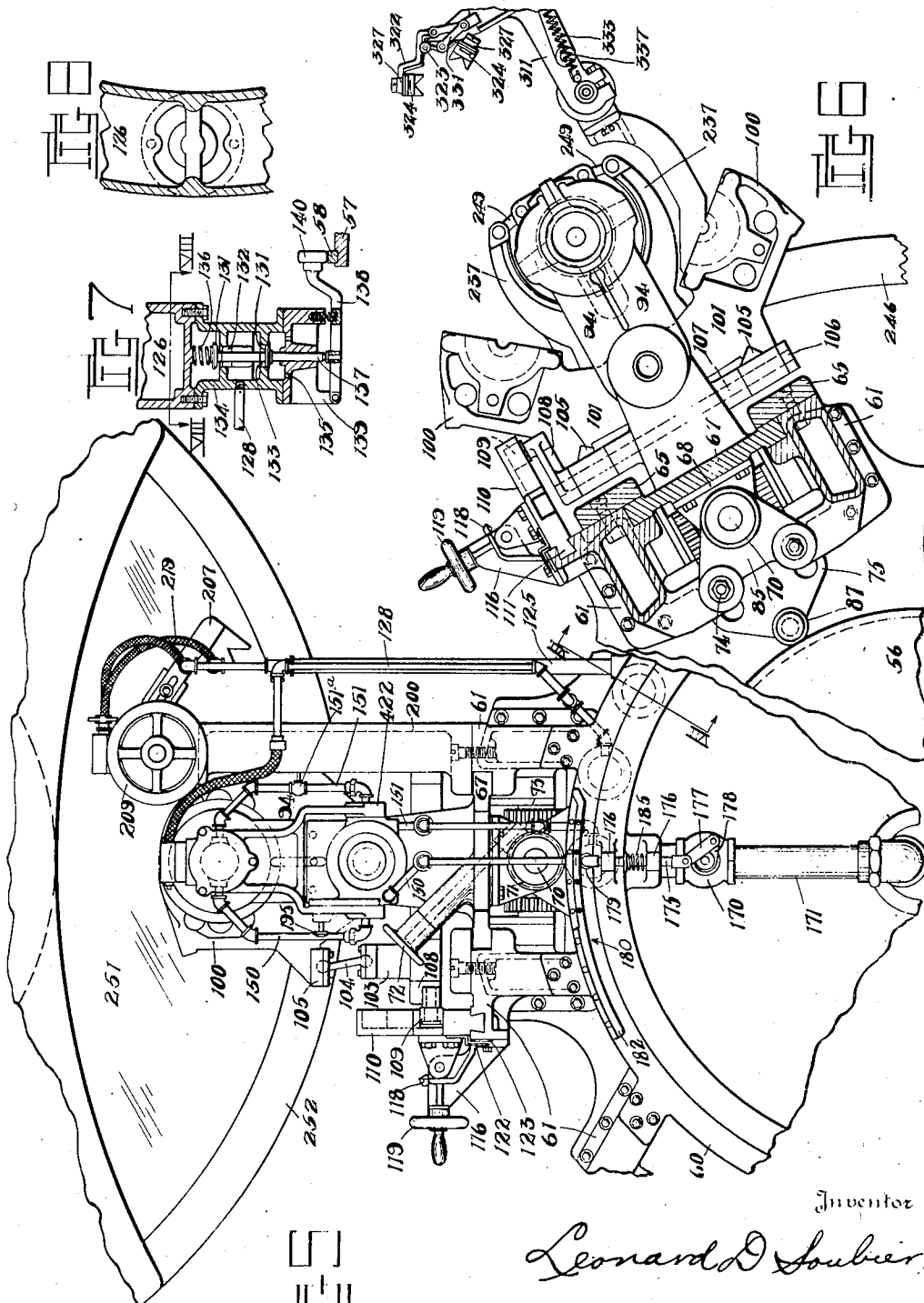
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GLASSWARE FORMING MACHINE

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13 Sheets-Sheet 3



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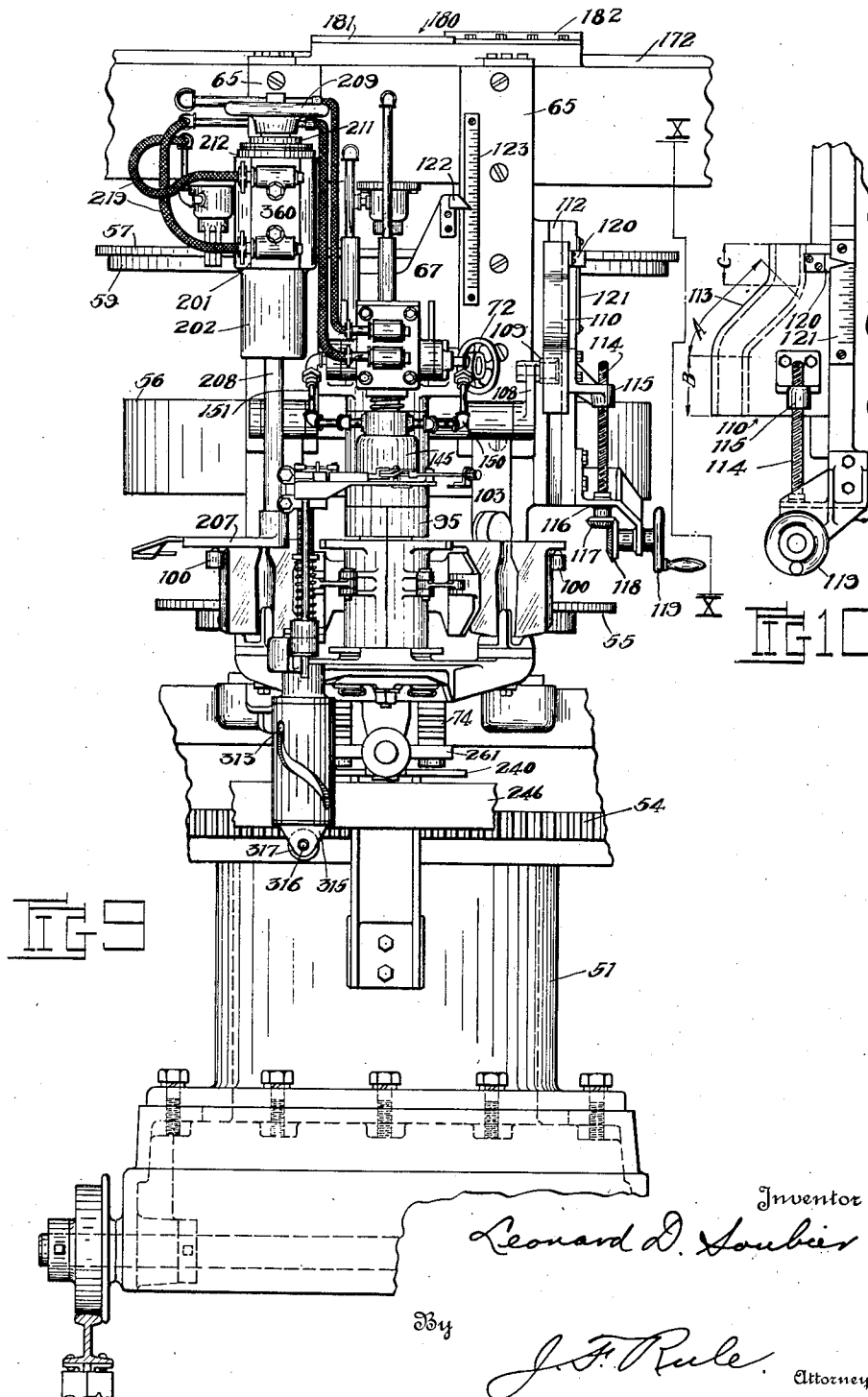
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GLASSWARE FORMING MACHINE

Original Filed Jan. 3, 1928 13 Sheets-Sheet 4



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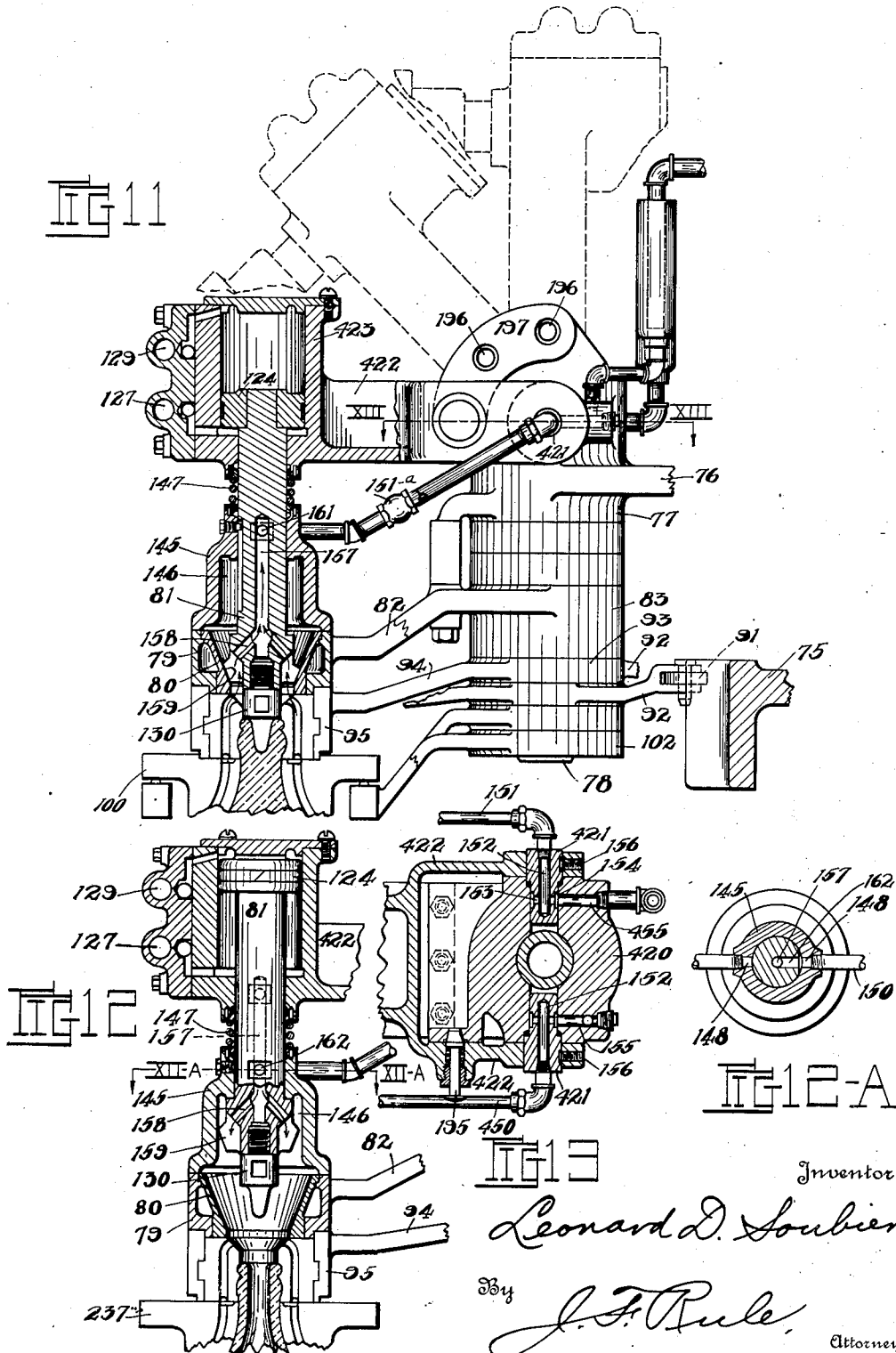
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13 Sheets-Sheet 6

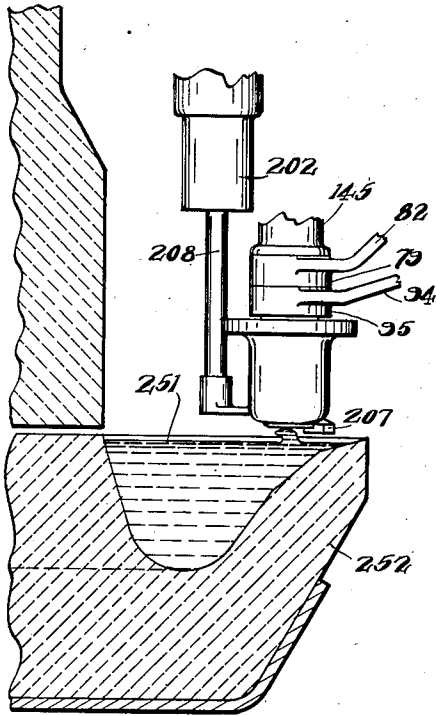


FIG 14

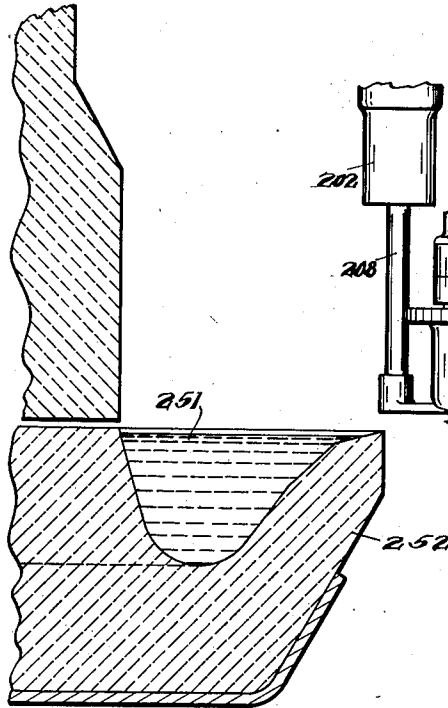


FIG 15

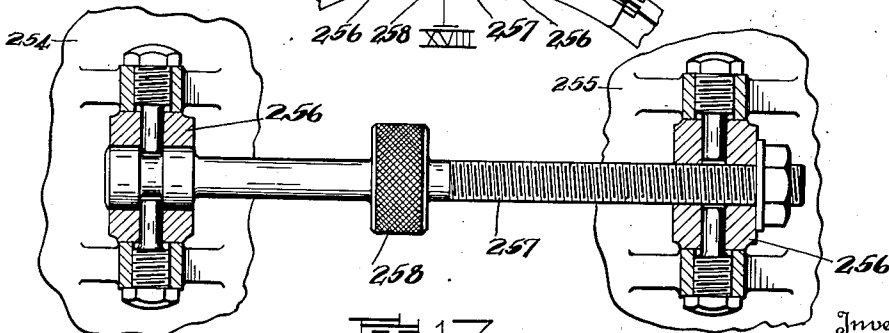
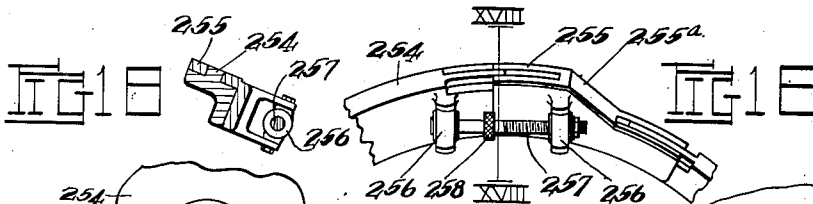


FIG 17

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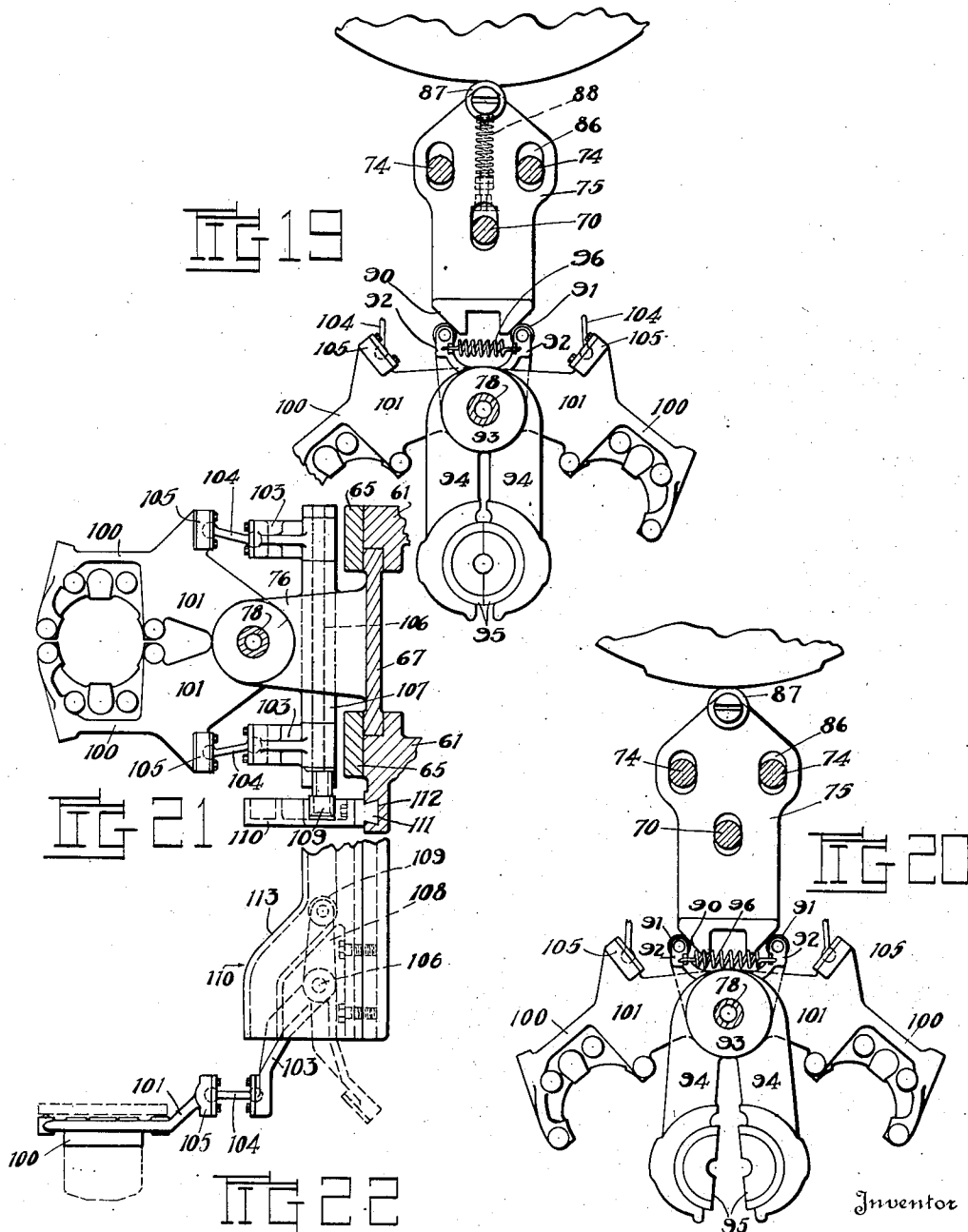
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# GLASSWARE FORMING MACHINE

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13 Sheets-Sheet 7



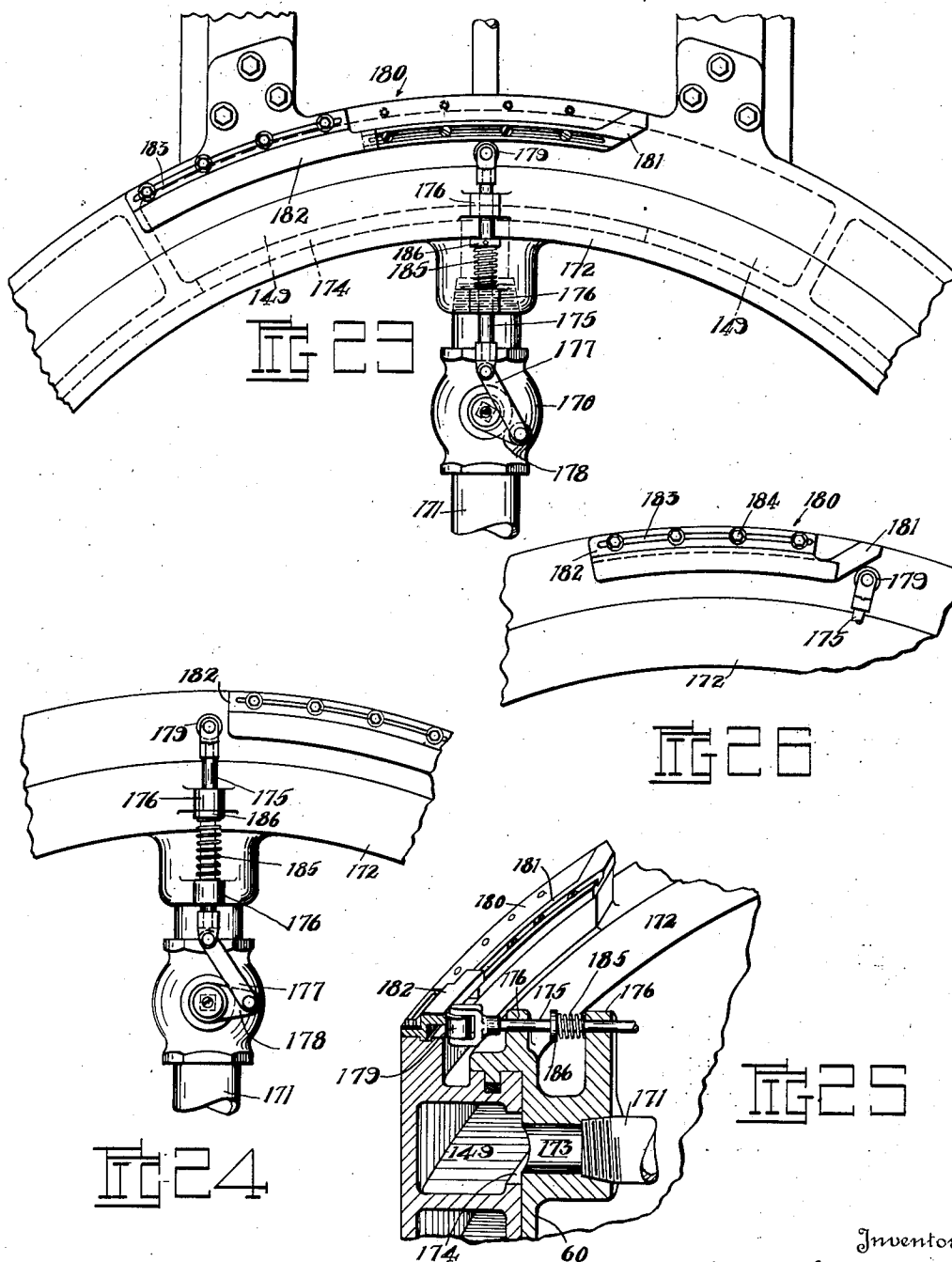
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GLASSWARE FORMING MACHINE

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GLASSWARE FORMING MACHINE

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13 Sheets-Sheet 9

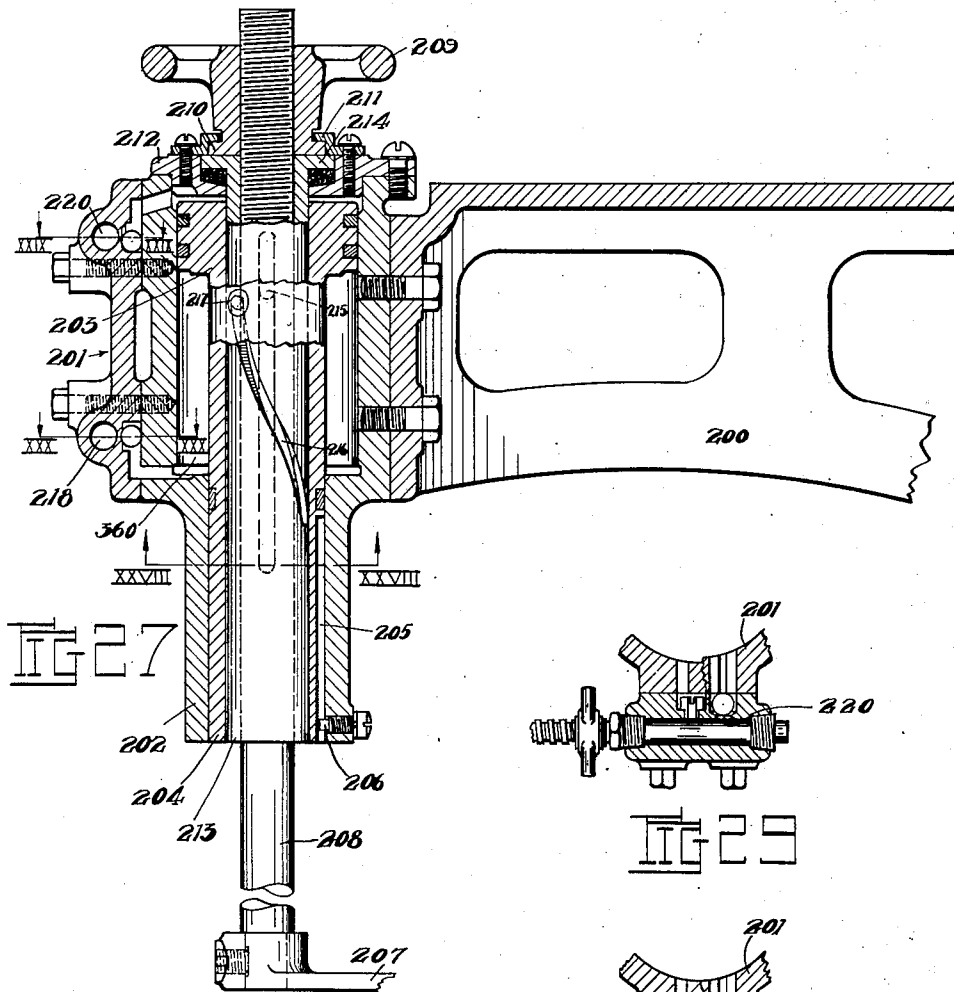


FIG 27

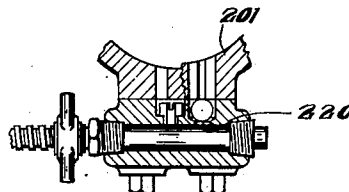


FIG 29

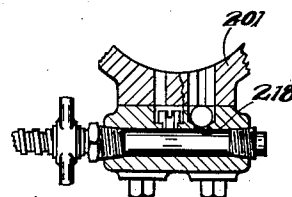


FIG 30

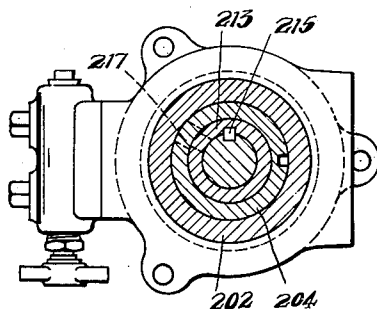


FIG 28

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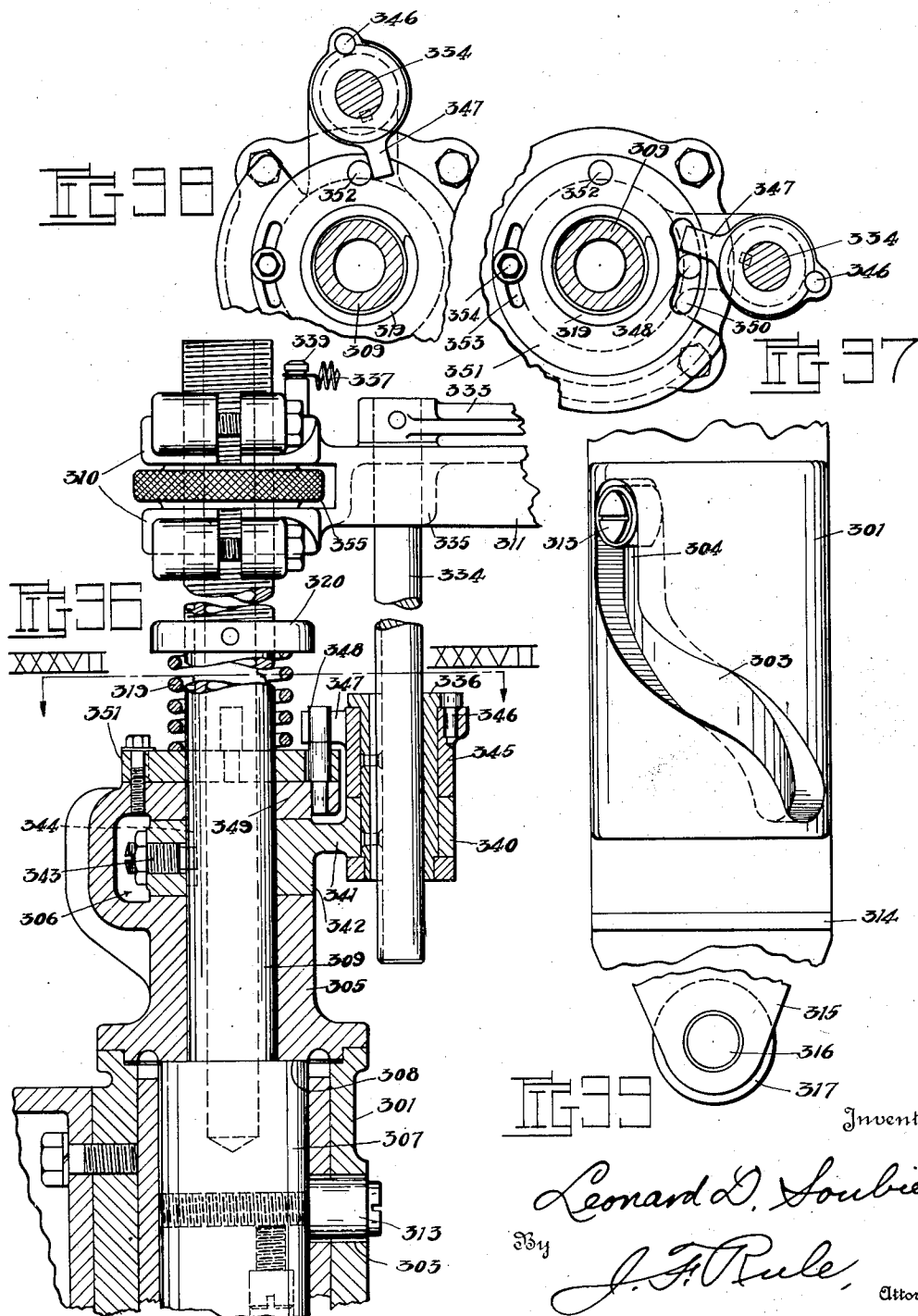
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GLASSWARE FORMING MACHINE

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13 Sheets-Sheet 11



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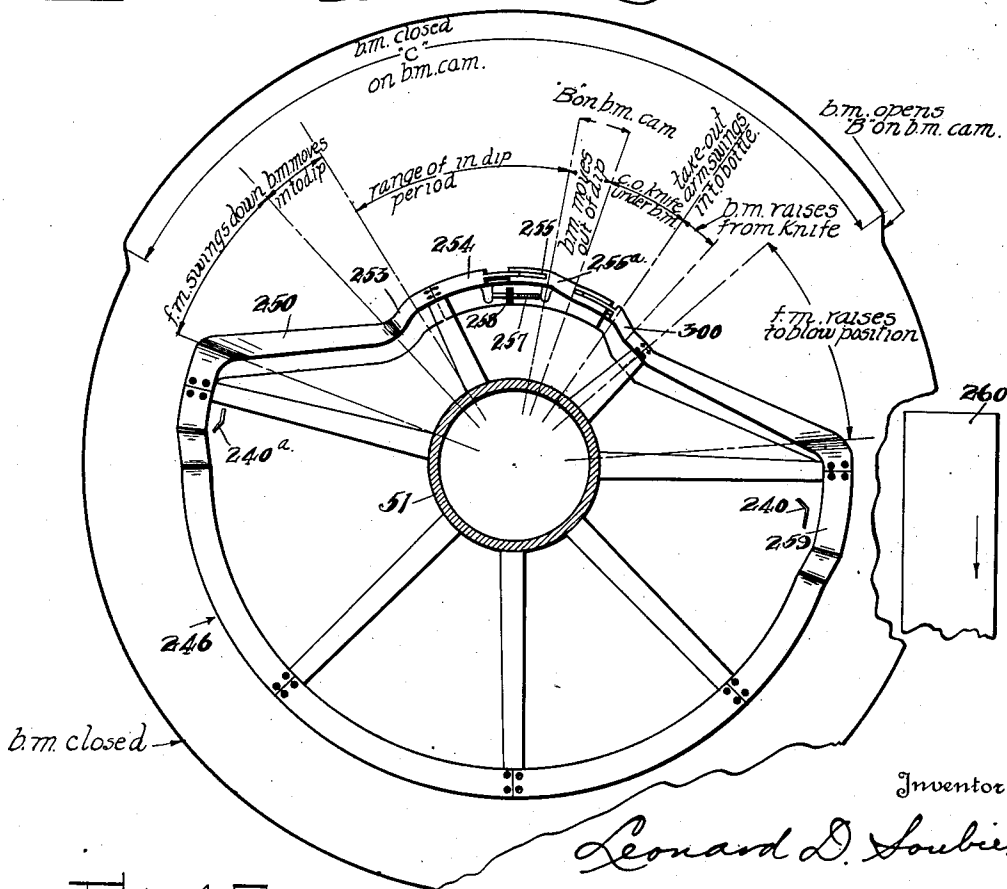
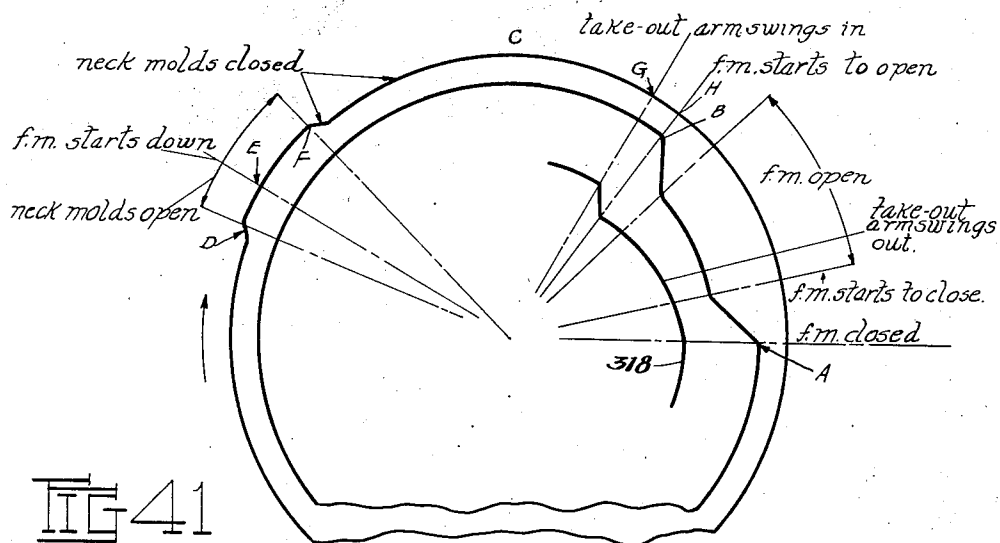
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GLASSWARE FORMING MACHINE

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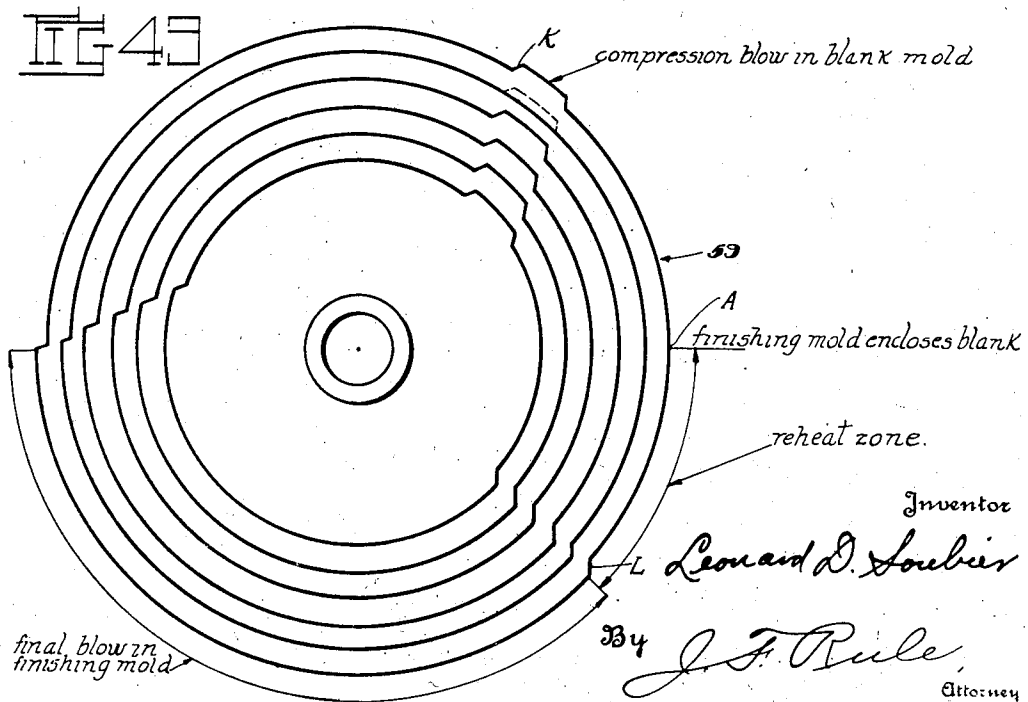
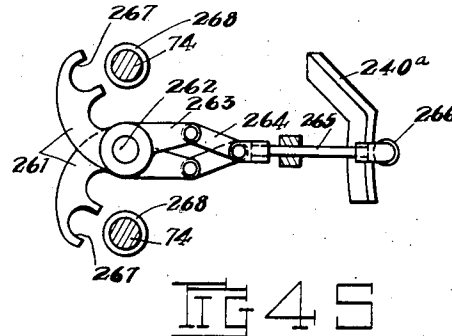
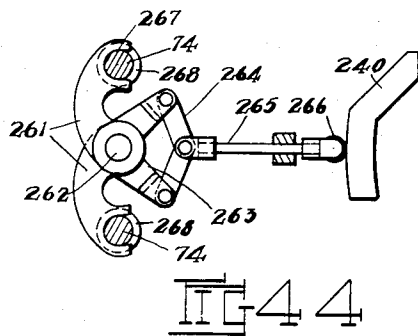
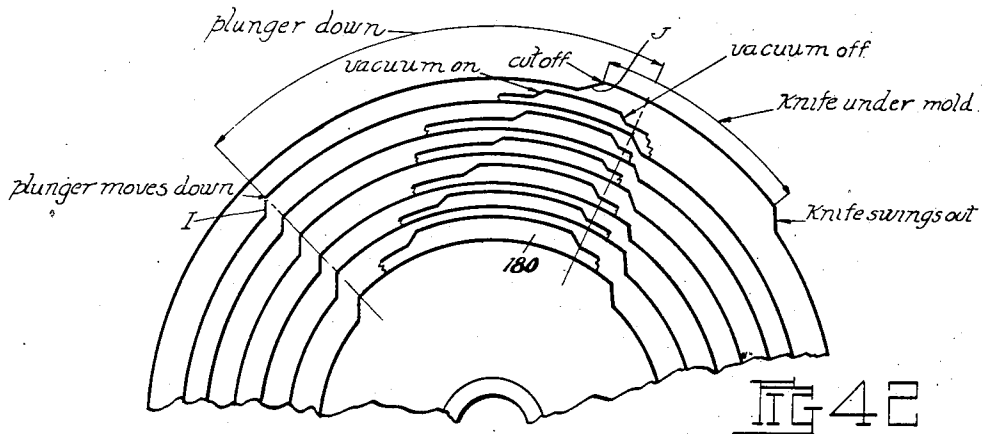
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GLASSWARE FORMING MACHINE

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13 Sheets-Sheet 13



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## UNITED STATES PATENT OFFICE

1,976,583

## GLASSWARE FORMING MACHINE

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Owens-Illinois Glass Company, Toledo, Ohio, a  
corporation of Ohio

Application January 3, 1928, Serial No. 244,147  
Renewed July 9, 1932

58 Claims. (Cl. 49—5)

The present invention relates to improvements in glassware forming machines in general, and more particularly to that type in which charges of glass are periodically gathered by suction into the blank molds at a charge gathering station.

An object of the present invention is to provide a machine of compact and simple construction embodying exceptional flexibility through which it may be utilized in the production of a wide range of glassware.

A further object is to provide a glassware forming machine of the above character including an annular series of mold groups each adjustable independently of the other whereby a single machine may be readily adjusted to simultaneously produce several different types and sizes of ware.

Another object is to provide a machine of the above character in which movement of the blank mold of each group is directly controlled by movement of the finishing mold of the same group and in which both molds are subject to periodic alternate movement toward and from each other. Thus, the period of time utilized in transferring a parison to the finishing mold is materially decreased with a resultant increase in operating speed and production.

A further object is to provide a machine of the above character in which the blank mold of each mold group moves downwardly at a predetermined point to a blank transfer station and while approaching this station, opens so that the blank may immediately be enclosed in the finishing mold at the transfer station. There is further provided means associated with the blank mold whereby the point at which said mold begins to open may be varied to thereby predetermine the period of time during which the blank is subjected to atmospheric exposure. This feature is of considerable value in that the condition of the glass or size of the blank or both, often necessitates a change in the point at which the blank mold opens so that the glass is subjected to long or short periods of exposure, these exposures controlling to a considerable degree the final thickness of the walls in the ware as well as the distribution of glass therein.

A still further object is to provide a novel form of plunger mechanism embodying means in part controlling the application of vacuum and air pressure to the blank and neck molds, said mechanism being adjustable to different elevations whereby parts thereof may be readily repaired or replaced.

The present invention further embodies means by which the period of application of vacuum

to the individual gathering molds may be readily adjusted as required by the type of ware being formed on each individual head.

It is likewise an object of the present invention to provide a machine of the above character with a novel form of ware take-out mechanism individual to the finishing mold of each group and operable to transfer ware directly to a suitable handling device.

Other objects will be apparent hereinafter.

In the accompanying drawings:

Fig. 1 is a part sectional elevation of one mold unit, illustrating the blank mold in charge gathering position and the finishing mold lowered for movement past the revolving pot or other molten glass container.

Fig. 2 is a view similar to Fig. 1, showing the finishing mold raised to a position to enclose a parison suspended from the neck mold.

Fig. 3 is a detailed sectional view taken along the line III—III of Fig. 2.

Fig. 4 is a sectional view taken along the line IV—IV of Fig. 3.

Fig. 5 is a plan view showing a mold unit at the charge gathering station, the blank molds being closed.

Fig. 6 is a part sectional plan showing a finishing mold at the blank transfer station, the blank mold being shown open.

Fig. 7 is a sectional view taken along the line VII—VII of Fig. 5.

Fig. 8 is a sectional view taken along the line VIII—VIII of Fig. 7.

Fig. 9 is a front elevation of one of the mold units showing the neck and finishing molds inter-engaged.

Fig. 10 is a detail view taken along the line X—X of Fig. 9, showing the adjustable cam for opening and closing the blank mold.

Fig. 11 is a fragmentary detail partly in section, showing the plunger and control mechanism therefor.

Fig. 12 is a view similar to Fig. 11, showing the plunger lifted away from the blank.

Fig. 12A is a sectional view taken along the line XIII—XIII of Fig. 12.

Fig. 13 is a sectional view taken along the line XIII—XIII of Fig. 11.

Fig. 14 is a fragmentary detail showing the gathering mold immediately following the charge gathering operation and at the time the mold is closed by the cut-off knife.

Fig. 15 is a view similar to Fig. 14, showing the mold lifted away from the cut-off knife.

Fig. 16 is a fragmentary detail of the adjustable

section of the cam which controls the finishing mold movements.

Fig. 17 is a detail sectional elevation showing the device for adjusting the cam section shown in Fig. 16.

Fig. 18 is a sectional view along the line XVIII—XVIII of Fig. 16.

Fig. 19 is a detail plan view showing the neck mold actuating mechanism, the neck mold being shown closed and the blank mold open.

Fig. 20 is a view similar to Fig. 19, showing the neck mold beginning to open.

Fig. 21 is a plan view showing the mechanism for controlling opening and closing of the blank mold.

Fig. 22 is a side elevation of the mechanism shown in Fig. 21.

Fig. 23 is a detail plan view showing the vacuum control valve and the adjustable cam for operating said valve, the latter being shown open.

Fig. 24 is a detail view showing the vacuum control valve closed.

Fig. 25 is a detail sectional perspective view of the vacuum chamber and mechanism for actuating the vacuum control valve.

Fig. 26 is a detail plan view showing the vacuum control cam in one of its adjusted positions.

Fig. 27 is a sectional elevation of the cut-off and its control mechanism.

Fig. 28 is a sectional view taken along the line XXVIII—XXVIII of Fig. 27.

Figs. 29 and 30 are sectional views taken along the lines XXIX—XXIX and XXX—XXX, respectively, of Fig. 27.

Fig. 31 is a detail plan view showing the ware take-out mechanism, the jaws thereof being open.

Fig. 32 is a view similar to Fig. 31, showing the jaws closed.

Fig. 33 is a side elevation of the take-out device supporting a bottle.

Fig. 34 is a sectional view along the line XXXIV—XXXIV of Fig. 32, showing the means for limiting swinging movement of the jaws.

Fig. 34A is a view similar to Fig. 34, showing one extreme position of the jaws.

Fig. 35 is a fragmentary side elevation of the upper portion of the take-out mechanism.

Fig. 36 is a detail sectional view of the upper portion of the take-out operating mechanism.

Fig. 37 is a sectional view taken along the line XXXVII—XXXVII of Fig. 36.

Fig. 38 is a view similar to Fig. 37, showing the elements shifted to another position in which the device is actuated to discharge a bottle.

Fig. 39 is a fragmentary elevation showing the pin and angular slot by which the take-out arm is oscillated and reciprocated.

Fig. 40 is a plan view of the blank mold cam and finishing mold lifting cam, together with the conveyor which receives the ware removed from the molds by the take-out device.

Fig. 41 is a diagrammatic illustration of the relative movements of the neck and finishing molds.

Fig. 42 is a diagrammatic illustration of the cams showing the manner in which the gathering periods may be varied to permit formation of different sized ware in the several molds of a single machine.

Fig. 43 is a diagrammatic view illustrating the blow cams and their formation relative to the closing of the finishing molds which permits formation of several sizes of ware on a single machine.

Fig. 44 shows the mold lock device just after it has been actuated by one of the cams.

Fig. 45 shows the device just after it has been unlocked.

In the preferred embodiment, the machine comprises a stationary vertical central pillar 50 rising from a circular hollow base 51 formed with an annular series of upwardly opening conduits 52 through which cooling air passes from the hollow base 51 to chambers 53 for cooling the molds as will be apparent hereinafter. These chambers 53, which are arranged in an annular series about the base 51 and form portions of the series of mold units, are rotatably mounted on the circular base member 51 and carry a ring gear 54 which is driven to continuously rotate the mold carriage. On the vertical pillar 50 (Figs. 1 and 2) is mounted a stationary cam 55 at a point in proximity to the cooling air chamber 53 for the purpose of operating mechanism to open and close the finishing molds. A stationary cam 56 is fixed to the pillar 50 at a point spaced above the finishing mold cam 55 and controls mechanism which opens and closes the neck molds. Just above the neck mold cam 56, a cam table 57 is rigidly mounted on the pillar 50 (Figs. 1 and 2) to support a series of plunger actuating cams 58 on its upper side, and a series of blowing air control cams 59 on its lower side. These cams (Figs. 1 and 2) correspond in number to that of the mold units mounted on the mold carriage. A cam 221 (Fig. 1) actuates a valve to control the cut-off knife as will be described later. At the upper end of the stationary central pillar 50, is rigidly mounted a circular plate 60 which supports means for supplying air pressure and controlling application of vacuum to the several mold units as will be apparent hereinafter.

Each mold unit is supported on a frame comprising a pair of vertical transversely spaced columns 61 having their upper ends bolted or otherwise secured to the outer walls of the air and vacuum chambers 126 and 149, respectively, (Fig. 1) and their lower ends resting on and secured to the upper side of the cooling air chamber 53. These columns 61 are hollow and formed with transverse partitions 62 adjacent their lower ends (Figs. 2 and 3) thereby providing in each column a relatively small chamber 63 communicating through ports 64 with the interior of the corresponding cooling air chamber 53. This construction and the provision of hollow mold arms, as is common in this art, provides for passage of cooling air from the chamber 53 to the finishing molds.

The outer corners of the adjacent faces of the two columns 61 are cut away to form channels, which, together with vertically extending plates 65 (Figs. 2 and 6), provide opposed guideways 66 in which a vertical slide 67 is mounted. A bearing block 68 (Figs. 1 and 2) is secured to the inner face of the slide 67 and is formed with a vertical opening in which is rotatably mounted a bearing sleeve 69 having a screw thread connection with an adjusting screw 70. A worm gear 71 is fixed to the sleeve 69 and bears against the under side of the bearing block 68. This worm gear 71 (Figs. 1 and 5) is rotatable by manual operation of a hand wheel 72 which is operable to rotate a worm 73 running in mesh with said worm gear 71. Rotation of the hand wheel 72 raises or lowers the slide 67 and thereby regulates the elevation of the neck mold and gathering head as will be apparent.

The screw 70 (Figs. 2 and 6) is suitably sup-

ported in a bracket 85 fixed to the upper ends of rack bars 74 hereinafter described, said bars and the lower end of the screw extending through radial slots 86 (Fig. 19) in a cam plate 75, the latter carrying a cam roll 87 at its inner end running upon the stationary neck mold cam 56 (Fig. 2). A coil spring 88 under compression interconnects the lower extended end of the screw 70 and a depending finger 89 arranged below the cam roll 87, said spring normally yieldingly holding the plate 75 at its innermost limit. The outer end of the cam plate 75 is formed with transversely spaced tapered cam faces 90 which at all times slidably engage rollers 91 carried by arms 92 connected through bearing plates 93 with the neck mold carrying arms 94, the latter supporting a partible neck mold 95. The neck mold (Fig. 1) is mounted on a hinge pin 78 depending from a head 77 carried by an arm 76 extending forwardly from the slide 67. A coil spring 96 (Fig. 19) interconnects the arms 92 and yieldingly holds the neck mold in closed position.

The gathering head (Figs. 2 and 11) which is supported on the hinge pin 78 may comprise a circular frame 79, in which a downwardly tapered sleeve 80 is removably arranged, the latter providing a seat on which the plunger rod 81 rests at intervals. The arm 82 supporting the gathering head, is connected to a collar 83 non-rotatably mounted on the hinge pin 78 and is also connected to the head 77 (Figs. 2 and 11) to insure rigid support for the gathering head.

The blank mold sections 100 (Figs. 11 and 21) are connected through arms 101 to bearing disks 102 mounted on the hinge pin 78. Each blank mold section 100 is connected through a link 104 (Figs. 21 and 22) to a rock arm 103, each link having a ball and socket connection at one end with said arm 103 and at the other end with an extension 105 on the mold arm 101. These rock arms 103 (Figs. 2, 6 and 21) are fixed to a transverse rock shaft 106 journaled in bearings 107 on the slide 67. One end of the rock shaft 106 extends beyond the rock arm 103 and carries a short rock arm 108 mounting at its outer end a cam roll 109 running in the path of an adjustable cam 110. This cam 110 is removably secured to a supporting block 111 slidably mounted for vertical adjustment, as hereinafter described, in a guideway 112 formed in the outer face of one of the columns 61 of the mold supporting frame. The cam path is formed with an offset 113 (Fig. 22) which, during downward movement of the blank mold unit causes rocking of the arms 108 and 103 and through the links 104 opens the blank mold.

In order to vary the elevation at which the blank mold opens and closes and thereby predetermine the extent of exposure of a blank to the atmosphere, this cam 110 is adjustable vertically by means of an adjusting screw 114 (Figs. 9 and 10), the upper end of which is threaded through a bracket 115 on said cam while the lower end is journaled in a bearing 116 and carries a bevel gear 117 running in mesh with a driving bevel gear 118 which is rotatable in either direction by a hand wheel 119. The cam carries a pointer 120 movable over a graduated scale 121 whereby the operator is guided in his adjustment of the cam so that its setting may be accurate and properly related to the height of the neck mold 95 as indicated by the pointer 122 (Fig. 9) and a graduated scale 123 which shows the height of the blanks being formed. Thus, the blanks may be retained in the blank mold or exposed to the atmosphere for any desired portion of the period

of downward movement of the blank mold to the elevation at which the blank is transferred to the finish mold. Adjustment of the hand wheel 119 to change the elevation of the cam 110 determines the point at which the blank mold opens.

Associated with each mold unit, is a plunger and controlling mechanism therefor, as shown in Figs. 1, 2 and 11 to 13, inclusive. The arm 76 which supports the hinge pin 78 is formed with a head 420 on its upper side having transversely aligned stub shafts 421 (Fig. 13) rotatably mounted therein and supporting a forwardly extending arm 422 for vertical swinging movement about the common axis of said shafts. An air motor 423 is carried at the outer end of the arm 422, a differential piston 124 therein being reciprocable vertically to transmit a corresponding movement to a plunger rod 81 which is connected to the piston and depends therefrom. Constant air pressure is applied to the lower side of the differential piston 124 through a supply pipe 125 (Figs. 2 and 5) from the air pressure chamber 126 by way of a valved port 127 in the wall of the motor cylinder to thereby normally hold the plunger rod 81 in its uppermost position. A pipe 160 continuously conveys air pressure to the chamber 126. At predetermined time intervals, air pressure is supplied from the chamber 126 through a pipe 128 and valved port 129 to the upper end of the motor cylinder to move the piston 124 and plunger rod 81 downwardly (Fig. 11). Such movement of the plunger rod projects the plunger tip 130 into the neck mold cavity to form an initial blow opening in the blank as is customary.

The valve mechanism controlling the supply of air pressure to the motor 423 is shown in Figs. 1 and 7 as comprising a pair of vertically spaced interconnected valve disks 131 adapted to alternately open and close ports 132 and 133 in vertically spaced transverse walls of a valve housing 134. The upper port 132 communicates directly with the air pressure supply chamber 126 while the lower port 133 communicates through a series of openings 135 with the atmosphere. A coil spring 136 normally yieldingly holds the upper valve disk 131 in a position to close the upper port 132 so that except at predetermined intervals, air pressure is not transmitted through the pipe 128 to the upper end of the motor 423. A push rod 137 axially aligned with the two valve disks, bears against the lower side of the lower valve disk 131 and rests upon a lever 138 pivoted at one end to a depending finger 139 on the valve housing. The other end of this lever carries a cam roll 140 which at times rides upon the face of one of the cams 58 mounted on the upper side of the aforementioned cam table 57. It is understood that there is provided a separate cam 58 for each mold unit of the machine and that these cams may be of different lengths depending upon the period of time during which the plunger tip is to remain in the neck mold cavity. With upward lifting of the push rod 137, the upper valve disk 131 is unseated, permitting air pressure to pass through the pipe 128 to the upper end of the cylinder of the air motor 423, thereby overcoming the pressure applied to the lower side of the piston 124 and causing the plunger tip to move downwardly as shown in Fig. 11. When the cam roll 140 passes beyond the cam 58, the lever 138 moves downwardly lowering the valve disk 131 and simultaneously closing the upper port 132. Thus, the air pressure above the piston 124 is exhausted through the pipe 128 and port 133 to the atmosphere, allowing said piston to again

move upwardly under influence of the constant pressure applied through the pipe 125 to the lower side of said piston.

A cap 145 is slidably mounted on the plunger rod 81 and normally rests upon the outer shell or frame 79 of the gathering head, the lower portion of said cap being spaced laterally from the plunger rod 81 and providing a chamber 146 communicating directly with the chamber within the tapered sleeve 80. A coil spring 147 encircling the upper portion of the plunger rod 81 normally yieldingly holds the cap 145 snugly seated upon the frame 79 and in spaced relation to the air motor 423. The upper portion of the cap 145 is formed with a pair of opposed ports 148 (Figs. 5 and 12A). One of these ports communicates through a pipe line 150 (Figs. 2 and 5) with the vacuum chamber 149, and the other with the air pressure chamber 126 through a pipe line 151, the latter provided with a valve 151<sup>a</sup> to assist in regulating flow of air pressure through the pipe.

The vacuum and air pressure pipes 150 and 151, respectively, each comprise a pair of sections interconnected by axial openings 152 in the stub shafts 421 (Fig. 13). The outer ends of the openings 152 are connected to the outer sections of the vacuum and air pressure pipes 150 and 151. These openings 152 communicate through radial ports 153 with annular channels or ways 154 which are at all times in register with ports 155 to which the inner sections of the vacuum and air pressure pipes 150 and 151, respectively, are connected. The stub shafts 421 are secured to the inner end of the arm 422 (Fig. 13) by set screws 156 or the like elements and have their inner ends journaled in bearings formed in the head 420. The inner sections of the air pressure and vacuum pipes each includes a pair of telescopic sections permitting vertical adjustment of the blank forming elements without interrupting communication between the vacuum and air pressure chambers and the neck mold.

The plunger rod 81 is formed with an axial passageway 157 opening at its lower end through a series of downwardly and outwardly inclined ports 158. The lower end of the plunger rod is formed with downwardly tapered faces 159 which seat upon the inner face of the sleeve 80 when the plunger tip 130 is projected into the neck mold 95. The upper end portion of the axial passageway 157 communicates with a radial port 161 (Fig. 11). This port 161 is in register with a port 148 (Fig. 12A) at times, the latter leading to the vacuum pipe 151 whereby the mold cavity may be vacuumized when the plunger tip 130 is projected into the neck mold as shown in Fig. 11. Spaced below the port 161 is another radial port 162. Upon upward movement of the plunger to the position shown in Fig. 12, this lower radial port 162 is brought into register with the port 148 leading to the air pressure pipe 151. Thus, the elements are alternately positioned to permit application of air pressure and vacuum to the mold cavities at proper intervals.

The vacuum control valve 170 (Figs. 1 and 23) is arranged in the vacuum pipe 171 leading into the vacuum chamber 149 by way of an opening in the inner wall of said chamber. The pipe 171 (Fig. 25) is threaded into an opening 173 in the upper end of an extension 172 on the top plate 60, formed with an opening 173 adapted for register during the period of application of vacuum with a longitudinal slot 174 formed in the inner wall of the vacuum chamber 149. A cam controlled push rod 175 is mounted in suitable bear-

ings 176 at the upper end of said extension 172, said rod having its inner end connected through a link 177 to a lever 178 carried by the valve. This push rod 175 carries a cam roll 179 which rides over a cam 180 during the period of vacuum application. This cam 180 (Figs. 23, 25 and 26) comprises two circumferentially adjustable sections 181 and 182 arranged upon the upper wall of the vacuum chamber and rotatable with the mold carriage. This adjustable section 182 is movable over the other section 181 and is formed with a longitudinal vertical slot 183 through which securing bolts 184 extend and by which this section 182 may be locked at any desired point to thereby control the length of the period of application of vacuum. The other section 181 is adjustable circumferentially to permit advance or retardation of the point at which vacuum is first applied. A coil spring 185 arranged between the inner bearing 176 and a collar 186 fixed to the push rod 175, serves to hold the vacuum valve 170 closed except when the corresponding gathering head is in charging position.

After termination of the application of vacuum and the plunger is removed from the neck mold, blowing air is applied through the air pressure pipe 151, such application being controlled by a valve 190 (Fig. 2) which provides communication between the air pressure pipe 151 and the air pressure chamber 126 through a port in the bottom wall of said chamber. This valve 190 is periodically opened by a lever 191 fulcrumed to a bracket 192, said lever carrying a roller engaging the stem 193 of the valve and the other end carrying a cam roll 194 which is periodically engaged by a patch on one of the cams 59 (Figs. 2 and 43). With such engagement between the cam roll 194 and one of the cam patches, the valve 190 is opened to thereby permit flow of air pressure through the pipe 151 to the blowing head and neck mold to form the initial blow opening in a blank. Frequently the blanks are of such size that the plunger alone forms a sufficiently large initial blow opening and the blowdown following removal of the plunger is unnecessary. Under these conditions, one or more of the cam patches are removed so that blowdown air pressure will not be applied to the blank.

From time to time, it may be necessary to lift the plunger controlling mechanism for repair or replacement of parts thereof, and accordingly there is provided, as shown in Figs. 11 and 13, a manually controllable spring pressed plunger 195 which may project into any one of a series of openings 196 formed in an upward arcuate extension 197 on the head 420 (Fig. 11), said plunger being carried by the arm 422. Thus, it is seen that the air motor 423 and the other plunger control mechanism may be held at any desired elevation while replacing or repairing parts thereof.

The "cut-off mechanism" which severs the charges from the supply body of glass and closes the blank molds, is mounted upon the outer end of a radial arm 200 supported on one of the mold frame columns 61. This arm carries at its outer end an air motor 201 (Figs. 2 and 27), the lower end of the motor cylinder 360 (Fig. 9) being formed with a depending tubular guide 202. A differential piston 203 is arranged in the motor cylinder and carries a relatively long piston rod in the form of a hollow shaft 204, extending downward through the guide 202. This shaft 204 is formed with a longitudinal channel or way 205 in its periphery into which a pin 206

projects to thereby prevent relative rotation between said shaft 204 and guide 202. The cut-off knife 207 is fixed to the lower end of a rod 208 which extends upwardly through the tubular shaft 204 and piston 203 and has its upper end threaded for engagement with a hand wheel 209, the latter being operable to vary the elevation of the knife 207. This hand wheel is formed with a radial peripheral rib 210 at its lower end which is taken over by a suitable retaining flange 211 secured to the head 212 of the air motor cylinder.

Interposed between the knife carrying rod 208 and the tubular shaft 204 is a sleeve 213 having a flange 214 at its upper end bearing against the lower end of the hand wheel and holding said sleeve against longitudinal movement. Relative rotation of the sleeve 213 and the knife carrying rod 208 is prevented by a vertical slot and pin connection 215 which permits vertical adjustment of the knife and rod relative to said sleeve. An angular slot 216 (Fig. 27) formed in the sleeve 213, slidably receives a pin 217 extending radially inward from the tubular shaft 204. With reciprocation of the piston 203, the tubular shaft 204 is correspondingly moved in the guide 202 so that an oscillatory movement is transmitted to the knife 207 through the sleeve 213 and rod 208.

Constant air pressure is applied to the lower side of the piston 203 (Fig. 27) through the air pressure pipe 125 and a valved port 218 adjacent the lower end of the air motor cylinder 360. This pipe 125, as previously stated, communicates directly with the air pressure chamber 126 (Fig. 2) to which air pressure is continuously supplied through a pipe 160. A pipe 219 (Fig. 5) periodically supplies air pressure from the chamber 126 to the upper end of the air motor cylinder 201 by way of a valved port 220 (Fig. 27) adjacent the upper end of said cylinder. A valve (not shown), similar to that shown in Fig. 7, and operable periodically by a cam 221 spaced outwardly from the cams 58 on the table 57 (Fig. 1) regulates application of air pressure to actuate the cut-off mechanism.

The finish mold (Figs. 1 to 4, inclusive) of each mold unit includes a hollow frame 230 formed with a pair of arms 231 (Fig. 3) which are journaled on stub shafts 232 mounted in bearings 233 formed in the mold frame columns 61. Each stub shaft 232 is hollow throughout a major portion of its length and opens into the chambers formed in the arms 231 of the finishing mold frame. Each stub shaft and the corresponding bearing 233 have aligned radial ports 64 by which communication is established between the hollow arms 231 and the air pressure chamber 53 (Figs. 2 and 3). A cap plate 234 is affixed to the outer end of the stub shaft 232 and is bolted or otherwise secured to the column 61. Thus, provision is made for the application of cooling air through the finishing mold arms 237 on the main frame to the finishing mold sections in a manner well known in the art and therefore not detailed in the present application. The finishing mold sections 235 are mounted on a common vertical hinge pin 236 (Fig. 2) and are connected by links 249 to hollow arms 237 which extend rearwardly and communicate with the air chambers in the arms 231 of the finishing mold frame. These mold section supporting arms 237 are connected through a link mechanism 243 to a slide 238 movable radially of the mold carriage in guideways 239 by the cam 55 on the stationary central pillar, said cam periodically moving the slide 238 radially outward through the medium of a cam roll 241

(Fig. 2) and thereby alternately opening and closing the molds.

Each of the supporting arms 231 of the finishing mold frame is formed with a gear segment 242 at its inner end running in mesh with one of the rack bars 74 which is slidable vertically in a suitable guide 361, which guide extends downwardly to the lower side of the corresponding air pressure chamber 53. Thus, vertical swinging movement of the finishing mold frame transmits through the gear segment and rack bar, vertical movement to the blank mold unit so that the neck and finishing molds may be alternately brought together and moved apart at proper intervals.

The finishing mold unit carries a roll 244 in suitable bearings 245 on its lower side, said roll running on a serpentine track 246 suitably supported on the circular stationary base 51. For reasons hereinafter apparent, there is provided a yielding adjustable connection between the roll 244 and the finishing mold frame 230. This connection comprises a pair of telescopic sections 247 (Fig. 1) having pin and slot connection to each other and normally held at their outermost limits by a spring 248. This unit, including the roll 244 may be adjusted vertically relative to the finishing mold frame 230 by any preferred means (not shown). One mechanism for effecting adjustment between this unit and the finishing mold frame is disclosed in Patent No. 1,185,687, granted June 6, 1916, to R. LaFrance, to which patent reference may be had for details. Each finishing mold unit is provided with removable counterweights 362 which assist in lowering the mold at regular intervals.

The track 246 (Fig. 40) which alternately raises and lowers the finishing mold unit, is of such shape that when the roll 244 reaches the area 250 thereof, the finishing mold swings downwardly and thereby lifts the gathering mold to a plane above the gathering area 251 of the supply body of glass in the trough 252. Movement of this roll 244 up the short incline 253, lifts the finishing mold and through the rack and gear mechanism lowers the blank mold a corresponding degree, causing the latter to dip into the glass. This dip or gathering position is maintained for a period of time determined by the length of the raised portion 254 of the track. This particular portion 254 is formed with a longitudinally adjustable section 255 having slidable connection to the adjacent ends of the track 246. One end portion of the track and the adjustable section are formed with bearing blocks 256 (Figs. 16, 17 and 18) mounting an adjusting screw 257 having a knurled finger piece 258 by which the screw is rotated to shift the adjustable section 255 to thereby lengthen or shorten the raised portion 254 of the track 246, and thereby control the length of the gathering operation. This adjustable section 255 is inclined at 255° so that it causes lowering of the finishing mold after a charge has been gathered, and consequently lifts the blank mold out of the glass. At a predetermined station 259 beyond the gathering trough 252, the finishing mold is lifted to its uppermost limit into engagement with the neck mold of the corresponding unit. At this station 259, the article formed in the molds during the cycle just completed is transferred from the finish mold, by a take-out device to be described hereinafter, to a conveyor or other ware handling device 260. The track elevation is slightly lowered at the station 259 and from this point on, the finish mold is held in engagement with the neck mold

95 by a lock device which cooperates with the rack bars 74 (Fig. 2) as will be pointed out.

This locking device (Figs. 44 and 45) comprises a pair of arms 261 interconnected by a hinge pin 262 depending from the air pressure chamber, said arms having fingers 263 connected by links 264 to a push rod 265 carrying at its inner end a cam roll 266 adapted for alternate periodic engagement with circumferentially spaced cam sections 240 and 240\* (Figs. 1, 2, 44 and 45). Each arm 262 is formed with a furcation 267 which straddles the lower end of one of the rack bars 74, said rack bars having their lower ends 268 formed to receive said furcations. The natural tendency of the rack bars 74 to move upwardly under influence of the weight of the finish mold frame 230, frictionally holds the locking device in engagement with the rack bars and obviates the necessity for providing a long continuous cam as a positive means for holding the locking devices in operative position. When the finish mold reaches the ware ejecting station, the cam roll 266 (Fig. 44) strikes the stationary cam 240 and causes swinging of the arms 261 into locking engagement with the lower ends of the rack bars 74 so that the finish mold and neck mold are interlocked. During movement of the finish mold between the two cam sections 240 and 240\* (Fig. 40), the cam roll carried by the finish mold is spaced slightly above the serpentine track so that connection between the finish and neck molds is solely dependent upon the locking device, the depressed portion of the track merely being provided as a precautionary measure. Upon engagement of the cam roll 266 with the cam 240\*, the arms 261 are moved away from the rack bars 74 so that the finish mold may be lowered away from the neck mold and thereby permit closing of the blank mold into engagement with the neck mold preparatory to gathering another charge of glass.

In the production of glassware on a machine of the above character, the mold carriage is continuously rotated to thereby bring the mold units in succession to a position in proximity to the trough 252 containing the supply body 251 of molten glass. As a mold unit approaches the gathering station, the finishing mold is first lowered by the dip 250 in the serpentine track 246 (Fig. 40) to thereby elevate the blank mold 100 to a plane in which it may pass over the rim of the trough. The finishing mold is then raised slightly by the high portion 254 of the serpentine track 246 to thereby transmit through the racks 74 and gear segments 242, a movement causing the blank mold 100 to dip into the supply body of glass. Just prior to charge gathering contact between the blank mold 100 and the molten glass in the trough, the rock arms 103 (Fig. 22) are moved forwardly to close the blank mold; the plunger 130 is projected into the neck mold by downward movement of the piston 124 of the air motor 423; and the neck mold 95 is closed by radial outward movement of the cam plate 75 (Figs. 1 and 19). The plunger 130 is lowered by application of air pressure to the upper side of the piston 124, this air pressure being supplied from the chamber 126 by way of a valve such as shown in Fig. 7. This valve remains open during and for a short period following the gathering of a charge of glass. While the elements are relatively positioned as above outlined, the vacuum control valve 170 (Figs. 1 and 23) is opened by the cam 180 to thereby permit application of vacuum to the blank mold in an obvious manner.

Upon completion of the charge gathering operation, the finishing mold is lowered due to the presence of the downward inclination of the adjustable track section 255 (Fig. 40) so that the blank mold is lifted above the surface of the supply body of molten glass, such lifting of the mold being combined with lateral movement thereof away from the gathering point. The cut-off knife 207 (Figs. 5 and 27) which is normally positioned at one side of the blank mold is swung inwardly to cut the string of glass from the bottom of the charge in the blank mold and to close the bottom of the blank mold cavity. This movement of the cut-off knife 207 is obtained by application of air pressure above the piston 203 (Fig. 27) which causes rotary movement of the knife 207 as previously described. The vacuum may be shut off at this point due to the cam 180 passing beyond the valve 170. After the completion of the cut-off operation and shut off of vacuum, and while the cut-off knife is positioned to close the bottom of the mold, the plunger 130 is lifted out of the neck mold 95 to the position shown in Fig. 12, so that air pressure may be applied to the glass in the neck and blank molds to compact the charge. This blowing air is obtained from the air pressure chamber 126 (Fig. 2) and is controlled by a valve 190 which is periodically opened by a cam 59. The air flows through the pressure pipes 151 and downwardly through the axial passageway 157 in the plunger rod 81 (Fig. 11). At the end of the cam 59, the air pressure is cut off by closing of the valve 190, and the cut-off knife 207 is swung laterally away from the blank mold. Just preceding this lateral movement of the knife, the blank mold is raised slightly away from the knife due to slight lowering of the finish mold which is caused by a drop 300 in the serpentine track 246 (Fig. 40).

Immediately following the removal of the cut-off knife 207, the finish mold, under influence of the serpentine track 246, begins to move upwardly toward the blank mold. The blank mold, as is understood from the foregoing description, also moves downwardly at a speed corresponding to that of the upward movement of the finishing mold due to the rack and gear segment between the blank and finish mold units. At a predetermined elevation, the rock arm 108 (Fig. 22) moves into the offset 113 in the path of the cam 110 so that the depending rock arms 103 are moved radially inward causing opening of the blank mold 100 and suspension of a bare formed parison from the neck mold 95. Continued relative movement of the blank and finish mold units toward each other, brings the finish mold sections 235 to a position at which they are moved inwardly toward each other to enclose the bare suspended parison. This closing movement of the finish mold is effected by the stationary cam 55 (Fig. 2) which controls movement of the slide 238, the latter being connected to the mold arms 237 by link mechanism 243 well known in the art.

Upon complete closing of the finishing mold about the parison, the locking device shown in Figs. 44 and 45 and including the furcated arms 261, is moved into operative position by the short cam 240 at the ware discharge station and thereby locks the finishing mold in its uppermost position where it cooperates with the neck mold 95. While so positioned, the air pressure control valve 190 is again opened to admit of application of air pressure to the blank which is now enclosed in the finishing mold. This application of air pressure blows the blank to its final form.

The finished articles are automatically removed from the finishing molds and deposited upon a suitable conveyor or ware handling device at a predetermined station by a take-out mechanism such as that shown in Figs. 31 to 39, inclusive. The take-out mechanisms are individual to the molds units and, as will be apparent, are adjustable as required by the type and size of ware being produced on the corresponding mold unit. Each take-out mechanism comprises a relatively long bearing sleeve 301 mounted on the outer end of a supporting arm 302 (Figs. 1 and 2), the latter being bolted or otherwise rigidly secured to the finishing mold frame 230. This bearing sleeve 301 is formed with an angular slot 303 (Fig. 39), there being provided a short straight portion 304 at the upper end of said slot for a purpose hereinafter apparent. A guide 305 extends upwardly from and axially of the bearing sleeve 301 (Fig. 36), said guide being removably secured to the bearing 301. This guide 305 is formed with a transverse slot 306 adjacent its upper end for a purpose hereinafter pointed out. A shaft 307 extends through the bearing sleeve 301 and at the upper end of said sleeve is reduced in diameter, forming an annular shoulder 308 which abuts the lower end of the guide 305. The reduced end 309 of the shaft is extended through said guide and has its upper end screw threaded for threaded engagement with collars 310 which support an arm 311 carrying the ware gripping jaws 312. The lower section of the shaft 307 within the bearing sleeve 301 removably carries a roll 313 which extends radially therefrom and moves in the angular slot 303. The lower end of the shaft 307 is secured to a bottom plate 314 formed with a depending finger 315 carrying a stub shaft 316 on which the cam roll 317 is mounted. This cam roll 317 is adapted for periodic engagement with a cam 318 (Fig. 41) which causes downward movement and consequent partial rotation of the shaft 307 at predetermined intervals. The shaft 307 is yieldingly normally held in its uppermost position by means of a coil expansion spring 319 which encircles the reduced end 309 of the shaft 307 between the guide 305 and an adjustable collar 320. The ware gripping jaws 312 are journaled on stub shafts 321 carried on the outer ends of angular arms 322 (Fig. 32), the latter being mounted on a vertical hinge pin 323. Each jaw 312 includes an upstanding flange 324 formed with an arcuate channel 325 in its upper edge to receive a pin 326 extending inwardly from a bearing plate 327 on the corresponding supporting arm 322. Thus, relative swinging movement between the jaws 312 and their supporting arms 322 is limited.

The main supporting arm 311, according to the present embodiment of the invention, is substantially L-shaped, as shown in Fig. 32. The laterally directed outer portion 328 is formed with longitudinal guides 329 for a slide 330 whose outer end is connected by links 331 to the arms 322 which carry the jaws 312. The inner end of the slide 330 is connected through an adjustable connector 332 to the outer end of the rock arm 333, pinned or otherwise rigidly secured to a supporting rod 334 which extends downwardly through a bearing 335 formed in the take-out arm 311, the lower end of said rod 334 being extended through a guide sleeve 336. A coil spring 337 above the rock arm 333 has its outer end connected to a pin 338 rising from the outer end of said rock arm, while its inner end is suitably connected to a pin 339 on one of the collars 310 which mount the

take-out arm 311 on the shaft 307. The function of this spring 337 will be apparent hereinafter.

The guide sleeve 336 (Fig. 36) which receives the lower end of the rod 334 is splined to the latter and in turn is journaled in a short vertical bearing 340 supported on an arm 341 which extends radially from a collar 342 mounted on the reduced end 309 of the shaft 307 in the transverse recess 306 in the guide 305. This collar 342 carries a pin 343 which projects into a longitudinal way 344 whereby the shaft 307 is permitted to move vertically relative to the collar 342 and to rotate therewith as a unit. A collar 345 rests upon the bearing 340 (Fig. 36) and encircles the upper portion of the guide sleeve 336 to which it is rigidly secured by a pin 346 or the like. A vertical pin 348 is carried by the upper portion 349 of the guide 305 and extends through an arcuate slot 350 in an adjustable plate 351 which carries another pin 352 at a point spaced circumferentially from the pin 348. This plate 351 is formed with a slot 353 at a point spaced from the first pin 348, said slot receiving a set screw 354 which permits rotation of the plate 351 and consequent placing of the two pins relative to each other as required by operating conditions. A radial finger 347 on the collar 345 is at all times disposed between the two pins 348 and 352.

In operating this take-out mechanism, the adjusting collar 355 is set to properly elevate the take-out arm 311 and jaws thereon in accordance with the height of the articles to be removed from the corresponding finishing mold. Just prior to upward movement of a finishing mold to a position to enclose a bare parison and while a finished article is enclosed in the finishing mold, the shaft 307 of the take-out device is pulled downwardly by the cam 318 with the result that this shaft is rotated to swing the take-out arm laterally inward toward the finishing mold. Simultaneously with this inward swinging of the arm, the latter is gradually lowered so that at the extreme inner end of its swinging movement, the jaws 312 are positioned at opposite sides of the neck of the article in the finishing mold. At the moment this position of the jaws is assumed, the radial finger 347 (Fig. 38) strikes the pin 352, causing the rock arm 333 (Fig. 32) to swing to the left and thereby close the jaws 312 as shown in Fig. 32. At this period, the finishing mold opens and simultaneously therewith the shaft 307 moves upward under influence of the coil expansion spring 319. This upward movement is again combined with a rotary movement on the part of the shaft 307, causing the take-out arm 311 to swing upwardly and laterally away from the finish mold, positioning the removed article directly over a conveyor or other ware handling device 260. At this point, the finger 347 (Fig. 37) strikes the pin 348 which causes the rock arm 333 to swing to the right and thereby open the jaws 312 and deposit the article upon said conveyor.

The coil spring 337 (Figs. 31 and 32) assists in swinging the arm 333 to its outermost positions to thereby positively actuate the ware gripping jaws 312. It is seen that when the arm has been rocked beyond a center line running through the axes of the pin 339 and rod 334, the spring 337 will quickly snap the arm to one of its outermost positions and thereby open or close the jaws 312.

By adjusting the length of the connector 332 (Fig. 32), the extent to which the jaws 312 close may be varied as required by the diameter of the

neck of the articles being removed from the finishing mold. The point at which the jaws 312 close is variable by loosening the set screw 354 (Fig. 37) and shifting the plate 351 circumferentially to change the location of the pin 352. These adjustments, together with vertical adjustment of the take-out arm 311 by means of the adjusting collar 355, provide means whereby the mechanism may be used with a wide range of ware.

By referring to Fig. 41, the relation between the movements of the neck and finish molds will be understood. The finish mold closes at station A and remains closed during movement of the finish mold around to station B beyond the charging station C. At station D just in advance of the charging station C, the neck mold opens so that the finish mold is free to move downwardly with the blown parison at station E and will pass beneath the trough of molten glass, such downward movement of the finish mold causing the blank mold to move upward preparatory to gathering a charge of glass. At station F, the neck mold is again closed so that the parison forming unit is ready to gather a charge from the trough. The ware take-out device swings in at station G just in advance of station H where the finish mold starts to open. Cam 318 (Fig. 41) actuates the take-out device. Between stations B and A, the cam is formed to open the finish mold so that the take-out device may swing outward and carry the blown article with it for transfer to the conveyor or other ware handling device 260. The finish mold is again completely closed at station A and the cycle just described is repeated.

By referring to Figs. 42 and 43, the application of vacuum and air pressure to glass in the molds will be understood. In Fig. 42, it is seen that the plungers move downwardly into the neck molds at station I, there being no variation in the relative points at which the plungers of the several mold units are projected into their respective molds. The vacuum cams 180, as previously described, may vary in length as shown in Fig. 42, and may be adjusted to change the point at which vacuum is initially applied, as well as the point at which it is terminated, these features being brought out in Fig. 23. Regardless of the length of the period of application of vacuum, the cut-off 207 is swung across the mold bottom at station J for the purpose of severing the charge and closing the mold bottom preparatory to applying a compression blow to the glass in the blank mold. By reference to Figs. 42 and 43 together, it is seen that the compression blow is applied at station K (Fig. 43) and that this station and the station at which the cut-off knife closes the mold are at substantially the same point. Where a relatively large blank is being formed, the vacuum will be applied for a greater length of time as indicated on the inner cam path of Fig. 42 than where a small blank is being formed and in which the cam is formed as indicated by the outside line in this figure. At station A (Fig. 43) which corresponds to station A in Fig. 41, the finish mold closes about the blank and at station L spaced from station A, final blowing air is applied to the blank. During the interval between stations A and L (Fig. 43), the parison is allowed to reheat in the finish mold to thereby eliminate any imperfections or scars which might otherwise show up in the finished ware. As illustrated in Fig. 43, the cams controlling the air pressure for the final blow

may vary in length depending upon the size of the blank being blown.

Modifications may be resorted to within the spirit and scope of the appended claims.

What I claim is:

1. A glassware forming machine comprising a rotary mold carriage, a pair of vertically spaced blank and finish molds thereon, means to move the finish mold vertically at regular intervals, and means actuated by movement of the finish mold to move the blank mold vertically.

2. A glassware forming machine comprising a rotary mold carriage, a blank mold mounted for vertical sliding movement thereon, a finish mold hinged below the blank mold to the mold carriage for vertical movement toward and from the blank mold, means to vertically move the finish mold at regular intervals, and connection between the molds through which vertical movement of the finish mold effects vertical movement of the blank mold in a direction opposite to that of the finish mold.

3. A glassware forming machine comprising a rotary mold carriage, mold groups thereon each comprising a pair of vertically spaced blank and finishing molds, means to move each finishing mold vertically at regular intervals, means actuated by movement of the finishing mold to move the corresponding blank mold vertically, and means individual to the mold groups to vary the spacing between the points of connection of the blank and finishing molds of each group to the mold carriage whereby molds of various sizes may be employed.

4. A glassware forming machine comprising a rotary mold carriage, a blank mold slidable vertically thereon, a finish mold hinged to the mold carriage below the blank mold, means to periodically move the finish mold vertically toward and from the blank mold, mechanism actuated by upward movement of the finish mold to simultaneously move the blank mold downwardly toward the finish mold to a blank transfer station, means to open the blank mold prior to arrival at the transfer station, and adjustable means to advance or retard the point at which the blank mold opens.

5. A glassware forming machine comprising a rotary mold carriage, a blank forming unit vertically movable thereon, a finish mold unit on said carriage, connections between the blank and finish mold units, and means to move the finish mold unit vertically at regular intervals and thereby transmit vertical movement to the blank mold unit.

6. A glassware forming machine comprising a rotary mold carriage, a blank mold and a neck mold mounted for vertical sliding movement thereon, a finishing mold mounted below the blank mold, means for moving the blank mold downward and the finishing mold upward on the mold carriage to a blowing level between the blank and finishing molds, cam means operable to open the blank mold during its said downward movement prior to arrival at the blowing level, and adjustable means to predetermine the point at which during said downward movement the blank mold opens.

7. A glassware forming machine comprising a rotary mold carriage, a blank mold and a neck mold mounted for vertical sliding movement thereon, a finish mold mounted below the blank mold for vertical movement on the mold carriage toward and from a blank transfer station between the blank and finish molds, means interconnecting

the mold units whereby vertical movement of one unit transmits vertical movement to the other unit, cam means to open the blank mold prior to arrival at the blank transfer station, and adjustable means to predetermine the point at which the blank mold opens.

8. A glassware forming machine comprising a rotary mold carriage, a blank mold and a neck mold mounted for vertical sliding movement thereon, a finish mold mounted below the blank mold for vertical movement on the mold carriage toward and from a blank transfer station between the blank and finish molds, means interconnecting the mold units whereby vertical movement of one unit transmits vertical movement to the other unit, means to adjust said connection to thereby vary the spaced relation between the bottom of the finish mold and the neck mold at the transfer station, cam means to open the blank mold prior to arrival at the blank transfer station, and adjustable means to predetermine the point at which the blank mold opens.

9. A glassware forming machine comprising a rotary mold carriage, a blank and neck mold mounted for vertical sliding movement thereon, a finish mold mounted below the blank mold for vertical movement on the mold carriage toward and from a blank transfer station between the blank and finish molds, means interconnecting the mold units whereby vertical movement of one unit transmits vertical movement to the other unit, means to adjust said connection to thereby vary the spaced relation between the bottom of the finish mold and the neck mold at the transfer station, said connection including a rack bar and gear segment operable by vertical movement of the finish mold, cam means to open the blank mold prior to arrival at the blank transfer station, and adjustable means to predetermine the point at which the blank mold opens.

10. A glassware forming machine including a rotary mold carriage, a slide vertically movable thereon, a vertical hinge pin supported by the slide, neck and blank molds on the hinge pin, a blow head arranged over the neck mold, plunger mechanism mounted for both vertical sliding and swinging movement relative to the slide, a vertically movable finish mold below the blank mold, and mechanism actuated by movement of the finish mold to move the slide vertically and correspondingly change the position of the elements carried thereby.

11. A glassware forming machine including a rotary mold carriage, a slide vertically movable thereon, a vertical hinge pin supported by the slide, neck and blank molds on the hinge pin, a blow head arranged over the neck mold, plunger mechanism mounted for both vertical sliding and swinging movement relative to the slide, a vertically swinging finish mold arranged below the blank mold, a gear segment thereon, a vertically slidable rack bar running in mesh with said gear segment, and connection between the rack bar and slide whereby vertical movement of the finish mold effects vertical movement of the slide and elements thereon.

12. A glassware forming machine including a rotary mold carriage, a slide vertically movable thereon, a vertical hinge pin supported by the slide, neck and blank molds on the hinge pin, a blow head arranged over the neck mold, plunger mechanism mounted for both vertical sliding and swinging movement relative to the slide, a vertically swinging finish mold arranged below the blank mold, a gear segment thereon, a vertically

slidable rack bar running in mesh with said gear segment, connection between the rack bar and slide whereby vertical movement of the finish mold effects vertical movement of the slide and elements thereon, and means included in said connection to adjust the slide and elements thereon vertically relative to the finish mold.

13. A glassware forming machine comprising a rotary mold carriage, a blank mold slidable vertically thereon, a finish mold mounted for vertical swinging movement on the mold carriage at a point below the blank mold, means interconnecting the molds and operating to transmit vertical movement to the blank mold from the finish mold, and automatic means operating to lock the finish mold against vertical movement during a predetermined period of time.

14. A glassware forming machine comprising a rotary mold carriage, a blank mold slidable vertically thereon, a finish mold mounted for vertical swinging movement on the mold carriage at a point below the blank mold, means interconnecting the molds and operating to transmit vertical movement to the blank mold from the finish mold, a locking device for the finish mold, and circumferentially spaced means to alternately actively and inactively position the locking device whereby the finish mold is positively held in its uppermost position for a predetermined period of time.

15. A machine for forming glass articles comprising, in combination, a mold carriage, means for rotating the carriage, a blank mold on the carriage, a finishing mold on the carriage below the blank mold, means for simultaneously moving said molds toward each other and thereby bringing them to a position for transferring a blank from the blank mold to the finishing mold, means for opening the blank mold prior to its arrival at said transfer position, and adjusting means to advance or retard the point at which the blank mold opens.

16. In a machine for forming glass articles, the combination of a blank mold and a finishing mold mounted to travel as a unit about a vertical axis, the finishing mold being spaced below the blank mold, means for moving the finishing mold upward at regular intervals, and mechanism interconnecting the molds and operable to transmit vertical movement to the blank mold from the finishing mold as the latter moves upward.

17. In a glassware forming machine, a mold carriage, a slide mounted for vertical movement thereon, parison forming elements carried by the slide, a finish mold arranged below the parison forming elements and hinged to the mold carriage for vertical swinging movement toward and from the parison forming elements, a carrier for the finish mold, and devices connecting the carrier and slide and actuated by vertical movement of the finish mold to cause vertical movement of the slide and elements on the latter.

18. In a glassware forming machine, a mold carriage, a slide mounted for vertical movement thereon, parison forming elements carried by the slide, a finish mold arranged below the parison forming elements and hinged to the mold carriage for vertical swinging movement toward and from the parison forming elements, a carrier for the finish mold, and devices connecting the carrier and slide and actuated by vertical swinging movement of the finish mold to cause vertical movement of the slide and elements on the latter, and means to adjust the slide relative to the finish mold whereby parison forming elements of varying sizes may be employed.

19. In a glassware forming machine, a mold carriage, a slide mounted for vertical movement thereon, parison forming elements carried by the slide, a finish mold arranged below the parison forming elements and hinged to the mold carriage for vertical swinging movement toward and from the parison forming elements, a rack bar and gear segment running in mesh with each other and actuated by a vertical, swinging movement of the finish mold, and connection between the rack bar and slide to transmit movement of the rack bar to the slide.
20. In a glassware forming machine, an annular series of blank molds adapted to gather charges one at a time by suction, vacuum chambers individual to the molds, connections between the molds and corresponding vacuum chambers, means to apply vacuum to each mold by way of the corresponding vacuum chamber, and devices individual to the molds, each adjustable to control the length of time vacuum is applied to the corresponding mold.
21. In a glassware forming machine, a rotary mold carriage, an annular series of blank molds thereon, means to lower the molds one at a time at a charge gathering station, and means adjustable without interrupting operation of the machine for varying the period of time during which the molds occupy the charge gathering position.
22. In a glassware forming machine, a rotary mold carriage, a blank mold mounted for vertical movement thereon, a finish mold mounted on the carriage below the blank mold for vertical swinging movement toward and from the latter, means whereby vertical movement of the finish mold moves the blank mold toward and from the finish mold in alternation, a stationary cam for raising and lowering the finish mold at predetermined stations to thereby position the blank mold for gathering a charge of molten glass, and means to adjust the cam without interrupting operation of the machine to change the length of the gathering operation.
23. In a glassware forming machine, a rotary mold carriage, a blank mold mounted for vertical movement thereon, a finish mold mounted on the carriage below the blank mold for vertical swinging movement toward and from the latter, means whereby vertical movement of the finish mold moves the blank mold toward and from the finish mold in alternation, a stationary cam for raising and lowering the finish mold at predetermined stations to thereby position the blank mold for gathering a charge of molten glass, a longitudinally adjustable section in the cam, and means to move the section to thereby vary the period of time during which the molds are lowered to a charge gathering position without interrupting operation of the machine.
24. In a glassware forming machine, a rotary mold carriage, a suction blank mold mounted for vertical movement on the mold carriage, a stationary cam shaped to control the lowering of the mold to a charge gathering position at a predetermined station, and means to adjust the cam to thereby control the period of time during which the blank mold occupies the charge gathering position.
25. In combination, a forming machine including a rotary mold carriage, a suction gathering mold mounted for vertical movement on the mold carriage, means to dip said mold into a supply body of molten glass to gather a charge therefrom, and means adjustable without interrupting operation of the machine to regulate the period of time during which the mold dips into the glass.
26. In combination, a forming machine including a rotary mold carriage, a suction gathering mold mounted for vertical movement on the mold carriage, means to dip said mold into a supply body of molten glass to gather a charge therefrom, and means adjustable without interrupting operation of the machine to regulate the period of time during which the mold dips into the glass, said adjustable means comprising an adjustable cam section shaped to lower the mold into charge gathering contact with the glass.
27. A glassware forming machine comprising a mold carriage, a partible blank mold thereon, means for moving the mold up and down on the carriage and thereby bringing it periodically to a blank transfer position, means operable during said movement of the mold to open the mold as it approaches said transfer position, and manually controlled means to change the point at which the mold is initially opened.
28. A glassware forming machine comprising a mold carriage, a partible blank mold thereon, means for moving the mold up and down on the carriage and thereby bringing it periodically to a blank transfer position, cam mechanism operable during said movement of the mold to open the blank mold prior to arrival at the blank transfer position, and manually controlled means to adjust the cam and thereby change the point at which the blank mold initially opens.
29. A glassware forming machine including a two section blank mold movable vertically toward and from a blank transfer point, rock arms connected to the mold sections, a stationary cam having a vertical cam path, and mechanism actuated by the cam during lowering of the mold to rock said arms and thereby open the mold.
30. A glassware forming machine including a two section blank mold movable vertically toward and from a blank transfer point, rock arms connected to the mold sections, a stationary cam having a vertical cam path, mechanism actuated by the cam during lowering of the mold to rock said arms and thereby open the mold, and means to vary the elevation of said cam and thereby predetermine and change the point at which the mold opens.
31. A glassware forming machine including a mold carriage, a slide mounted for vertical reciprocating movement thereon, a two section blank mold on the slide, and means actuated by vertical movement of the slide to alternately open and close said mold.
32. A glassware forming machine including a mold carriage, a slide mounted for vertical reciprocating movement thereon, a two section blank mold on the slide, and cam mechanism actuated by vertical movement of the mold and slide to alternately open and close the mold at vertically spaced points.
33. A glassware forming machine including a mold carriage, a slide mounted for vertical reciprocating movement thereon, a two section blank mold on the slide, cam mechanism actuated by vertical movement of the mold and slide to alternately open and close the mold at vertically spaced points, and means whereby the cam mechanism may be adjusted to change the elevation at which the blank mold opens.
34. A glassware forming machine including a rotary mold carriage, an annular series of suc-

tion gathering molds thereon, means to apply vacuum to the molds one at a time, said means including vacuum chambers individual to each mold, pipe connections between each vacuum chamber and the corresponding mold, a vacuum pipe communicating with the interior of the chambers one at a time, and a vacuum control valve in said pipe.

annular series of blank molds rotatable about a vertical axis, means to apply vacuum to the molds, and means individual to and traveling with the molds to control the length of the periods of application of vacuum, said last named means including an adjustable cam traveling with each mold unit.

35. A glassware forming machine including a rotary mold carriage, an annular series of suction gathering molds thereon, means to apply vacuum to the molds one at a time, said means including vacuum chambers individual to each mold, pipe connections between each vacuum chamber and the corresponding mold, a vacuum pipe communicating with the interior of the chambers one at a time, a vacuum control valve in said pipe, and cam mechanism alternately opening and closing the valve at regular intervals.

42. A glassware forming machine including an annular series of blank molds rotatable about a vertical axis, means to apply differential pressure to the blank mold cavities, and means individual to the molds to vary the length of the periods of application of said pressure.

36. A glassware forming machine including a rotary mold carriage, an annular series of suction gathering molds thereon, means to apply vacuum to the molds one at a time, said means including vacuum chambers individual to each mold, pipe connections between each vacuum chamber and the corresponding mold, a vacuum pipe communicating with the interior of the chambers one at a time, a vacuum control valve in said pipe, cam mechanisms individual to the molds, each operable to open and close the valve at regular intervals, and means for individually adjusting said mechanisms and thereby individually adjusting the periods of application of vacuum to the respective molds.

43. A machine for forming glass articles comprising a rotary mold carriage, a blank forming unit thereon, a finishing mold unit thereon, operating connections between said units, and means for moving the finishing mold unit relative to the mold carriage at regular intervals and thereby transmitting movement to the blank mold unit through said connections.

37. A glassware forming machine including a rotary mold carriage, an annular series of suction gathering molds thereon, means to apply vacuum to the molds one at a time, said means including vacuum chambers individual to each mold, pipe connections between each vacuum chamber and the corresponding mold, a vacuum pipe communicating with the interior of the chambers one at a time, a vacuum control valve in said pipe, a cam individual to each mold, and mechanism actuated by the cams to alternately open and close the vacuum control valve at regular intervals.

44. A machine for forming glass articles comprising a traveling mold carriage, a blank mold and a finishing mold on said carriage, operating connections between said molds, and means controlled by the travel of the mold carriage to periodically move one of said molds toward a blank transfer position and through said connections move the other mold toward a blank transfer position.

38. A glassware forming machine including a rotary mold carriage, an annular series of suction gathering molds thereon, means to apply vacuum to the molds one at a time, said means including vacuum chambers individual to each mold, pipe connections between each vacuum chamber and the corresponding mold, a vacuum pipe communicating with the interior of the chambers one at a time, a vacuum control valve in said pipe, a cam individual to each mold, mechanism actuated by the cams to alternately open and close the vacuum control valve at regular intervals, and means to adjust the cams to thereby vary the period of application of vacuum to the molds.

45. A machine for forming glass articles including a mold carriage, a slide mounted for reciprocating movement thereon, a two-section blank mold on the slide, and means actuated by said reciprocating movement of the slide to alternately open and close the mold.

39. A glassware forming machine including an annular series of suction blank molds rotatable about a vertical axis, means to apply vacuum to the molds one at a time at a predetermined station, and means individual to the molds to vary the length of the periods of vacuum application.

46. A machine for forming glass articles including a mold carriage, a slide mounted for reciprocating movement thereon, a two-section blank mold on the slide, and cam mechanism actuated by said movement of the slide to alternately open and close the mold at points on the mold carriage spaced in the direction of said reciprocating movement.

40. A glassware forming machine including an annular series of blank molds rotatable about a vertical axis, means to apply vacuum to the molds, and means individual to and traveling with the molds to control the length of the periods of application of vacuum.

47. The combination of a mold, a cut-off mechanism including a vertically disposed air motor, a rock shaft extending axially therethrough, a differential piston in the motor having pin and angular slot connection with the rock shaft, a cut-off knife carried by the rock shaft, and automatic means to reciprocate the piston at regular intervals and thereby alternately move the knife into and out of a position to close the charge receiving end of the mold.

41. A glassware forming machine including an

48. The combination of a mold, a cut-off mechanism including a vertically disposed air motor, a rock shaft extending axially therethrough, a differential piston in the motor having pin and angular slot connection with the rock shaft, a cut-off knife carried by the rock shaft, automatic means to reciprocate the piston at regular intervals and thereby alternately move the knife into and out of a position to close the charge receiving end of the mold, and means to lift the mold away from the knife.

49. The combination of a mold, a cut-off mechanism including a vertically disposed air motor, a rock shaft extending axially therethrough, a differential piston in the motor having pin and angular slot connection with the rock shaft, a cut-off knife carried by the rock shaft, automatic means to reciprocate the piston at regular intervals and thereby alternately move the knife into and out of a position to close the charge receiving end of the mold, and means to adjust the rock

shaft in the direction of its length to change the elevation of the knife.

50. In a machine for forming glass articles, the combination of a piston motor, a reciprocating piston therein, said piston having a central opening, a rock shaft extending through said opening, a knife carried by said rock shaft, and a slot and pin connection between the motor piston and said shaft by which reciprocating movement of the piston transmits rocking movement to said shaft.

51. In a machine for forming glass articles, the combination of a piston motor comprising a reciprocating piston formed with an opening there-through and having a cylindrical extension forming a hollow piston rod, a rock shaft having a telescoping connection with said piston rod, a knife carried by the rock shaft, means for holding the rock shaft against movement in the direction of its length, means for preventing rotation of the piston, and a slot and pin connection between the rock shaft and said piston rod by which reciprocation of the piston imparts a rocking movement to said shaft.

52. In a machine for forming glass articles, the combination of a piston motor comprising a cylinder, a piston therein, a tubular piston rod, said piston having a central opening aligned with the piston rod, a rock shaft extending through said piston rod and piston with its ends extended beyond the motor, a knife arm attached to one end of the rock shaft, an adjusting wheel having a threaded connection with the other end of the rock shaft for adjusting the latter in the direction of its length, means to prevent rotation of the piston rod, and a slot and pin connection between the piston rod and rock shaft by which reciprocation of the piston rocks said shaft.

53. In a machine for forming glass articles, the combination of a blank mold, a plunger projecting thereinto, means for introducing a charge of glass into the mold, means for then withdrawing the plunger, means for supplying air under pressure to the initial blow opening formed by the plunger, and means individual to the mold for controlling the length of time the air pressure is applied.

54. In a machine for forming glass articles, the combination of a mold carriage, a blank mold thereon, means for periodically bringing the mold into contact with a supply body of molten glass and introducing a charge of glass into the mold by suction, a plunger projecting into the mold for forming an initial blow opening in the blank of glass, means for withdrawing the plunger, means for compressing the glass in the mold by air pressure supplied at said initial blow opening,

and means individual to the mold for controlling the length of time the air pressure is applied.

55. A glass forming machine comprising an annular series of partible molds rotatable about a vertical axis, cam mechanisms individual to the molds to control the opening and closing movements thereof, and means for adjusting said mechanisms to change the relative positions of the points at which the molds are opened.

56. In a machine for forming glass articles, the combination of a mold carriage, means for rotating it, a plurality of molds mounted to rotate with the carriage, each mold comprising separable sections, mechanisms for opening the molds, cams individual to the molds for actuating said mechanisms, and means for individually adjusting said cams and thereby adjustably varying the points at which the molds are opened.

57. In a machine for forming hollow glass articles, the combination of a mold carriage, means for rotating it, a plurality of mold groups thereon, each comprising a blank mold and a finishing mold, means for forming parisons in the blank molds, means for transferring the parisons to the finishing molds, means for blowing the parisons to finished form in the finishing molds, and means individual to the mold groups for controlling the length of time the blowing operation is maintained in each finishing mold.

58. In a machine for forming glass articles, the combination of a blank mold open at its lower end to receive a charge of glass, a neck mold above and in register with the blank mold, a gathering head above and in register with the neck mold, said gathering head including a chamber communicating with the mold cavities and having a vertical bore through its upper end in register with said cavities, air pressure and vacuum lines including a pair of opposed ports opening into said bore, a piston motor including a vertically reciprocating piston and piston rod above and coaxial with the gathering head, said rod slidably extending through the bore in said head, a plunger at the lower end of the rod, means for operating the motor to thereby alternately raise and lower the plunger relative to the neck mold, and means including a longitudinal conduit in the rod and longitudinally spaced radial ports opening into said conduit for effecting alternate application of air under pressure and vacuum to said gathering head and mold cavities, said rod in one position effecting communication between one of said radial ports and the vacuum line and in its other position effecting communication between the second radial port and the air pressure supply line.

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