

April 24, 1934.

K. E. PEILER

1,955,765

METHOD OF AND APPARATUS FOR FORMING HOLLOW GLASSWARE

Filed Aug. 31, 1931

6 Sheets-Sheet 2

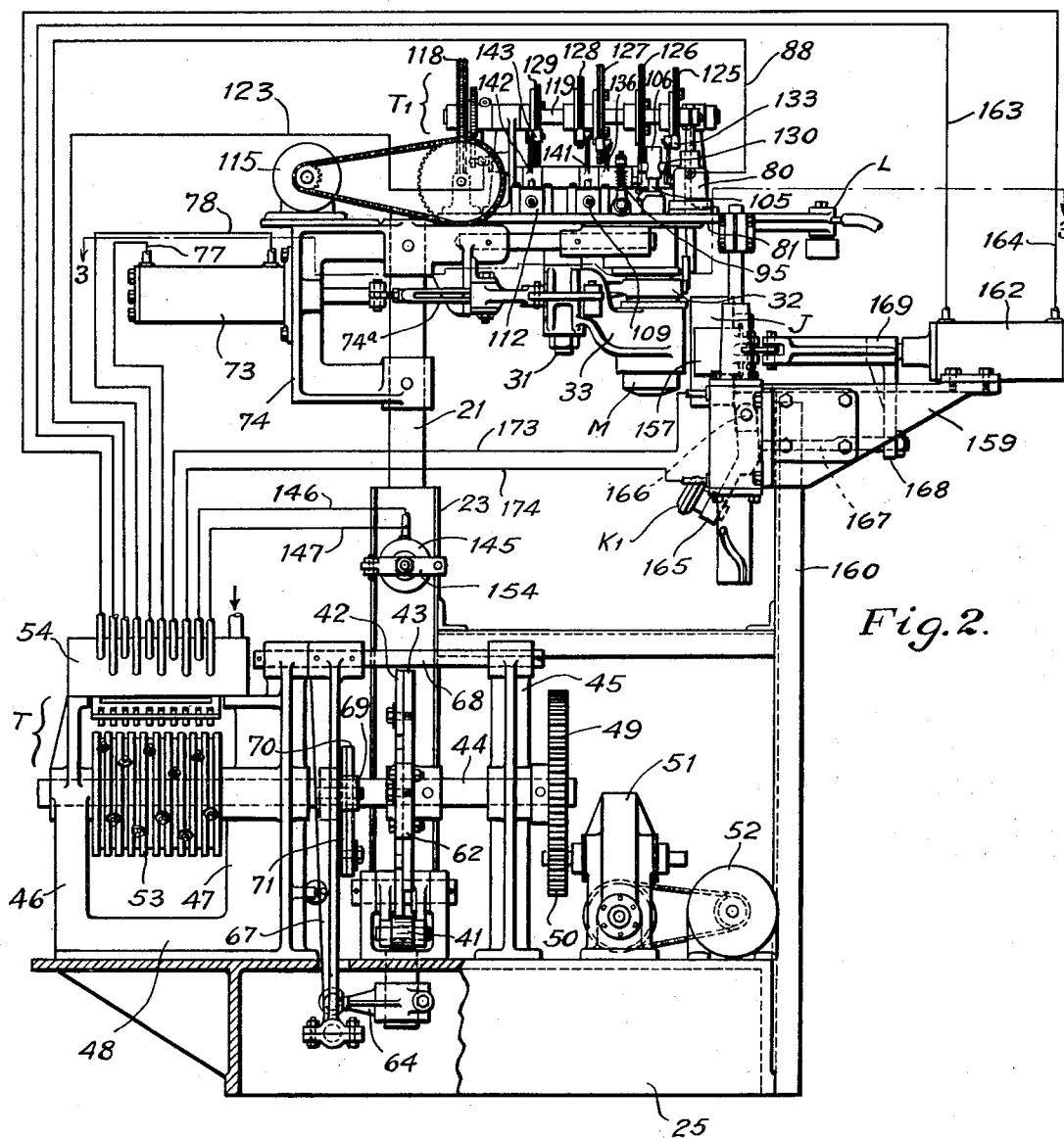


Fig. 2.

Witness:
G. A. Klueberg.
A. A. Horn

Inventor:
Karl E. Peiler
by Brown & Parkman
Attorneys.

April 24, 1934.

K. E. PEILER

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Fig. 3.

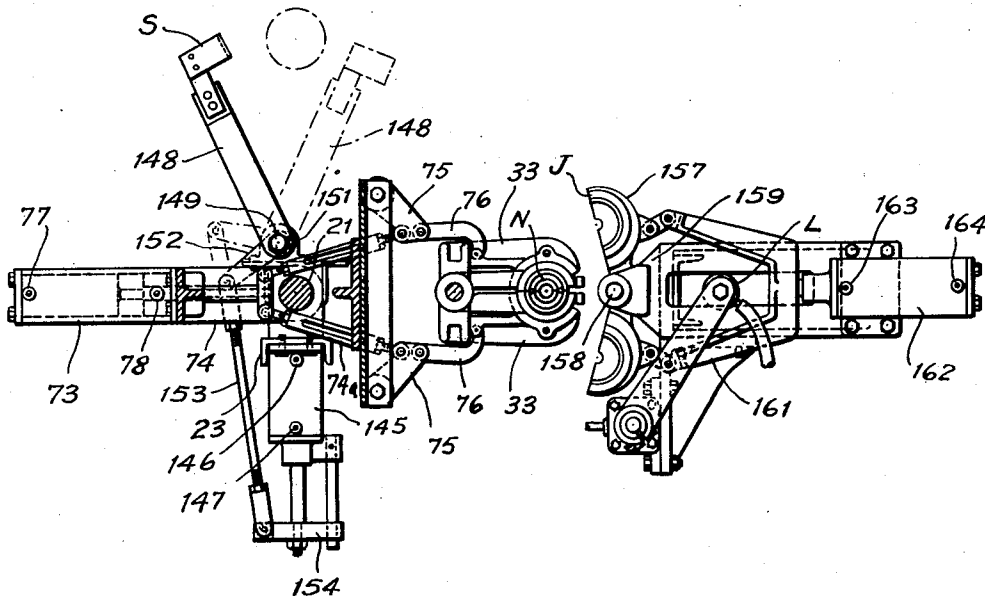
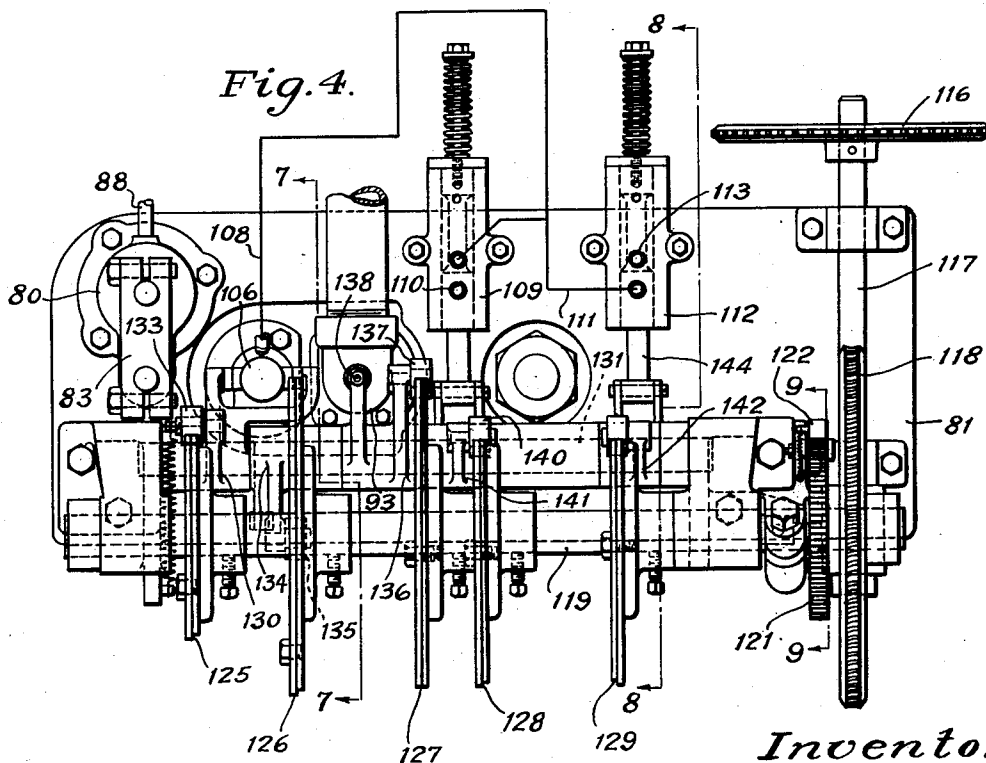


Fig. 4.



Witness:

G. A. Kluberg
A. G. Horn

Inventor:
Karl E. Peiler
by Brown & Parkam
Attorneys.

April 24, 1934.

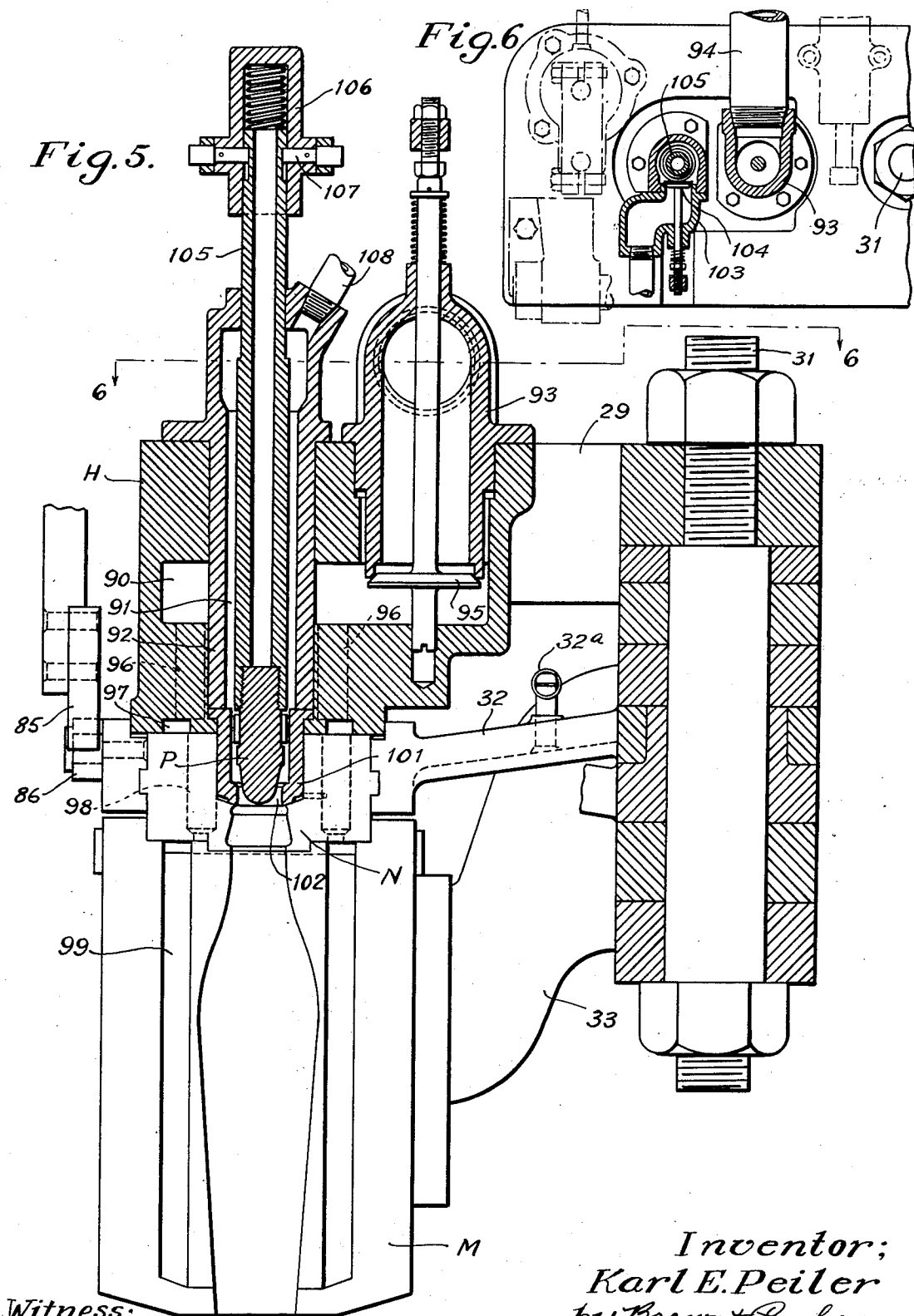
K. E. PEILER

1,955,765

METHOD OF AND APPARATUS FOR FORMING HOLLOW GLASSWARE

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6 Sheets-Sheet 4



Witness:
G. A. Oberg
A. A. Horn

Inventor;
Karl E. Peiler
by Brown & Parkham
Attorneys.

April 24, 1934.

K. E. PEILER

1,955,765

METHOD OF AND APPARATUS FOR FORMING HOLLOW GLASSWARE

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Fig. 7.

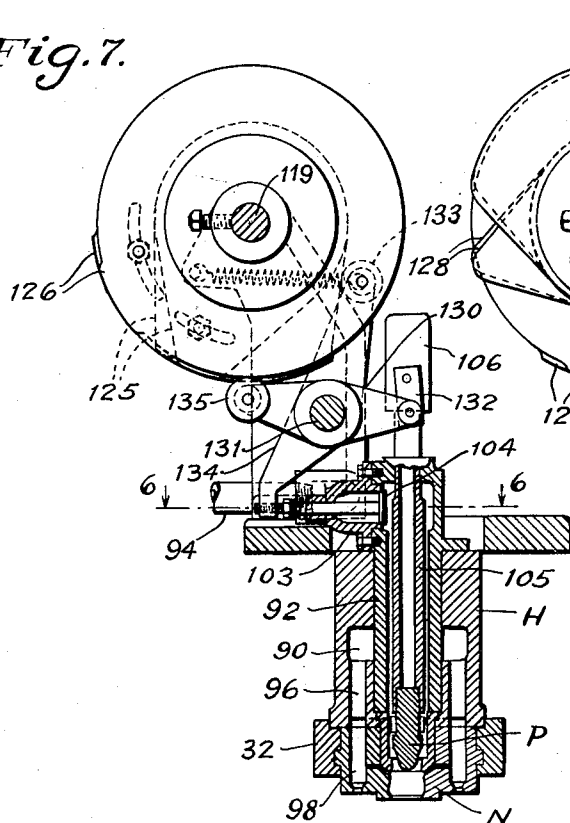


Fig. 8.

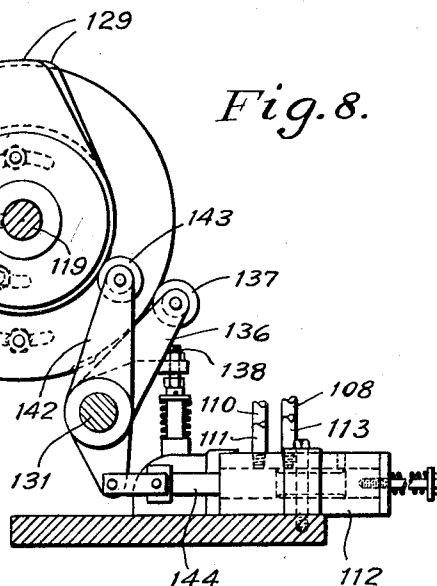


Fig. 11.

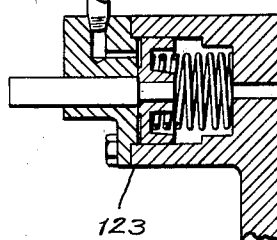


Fig. 10.

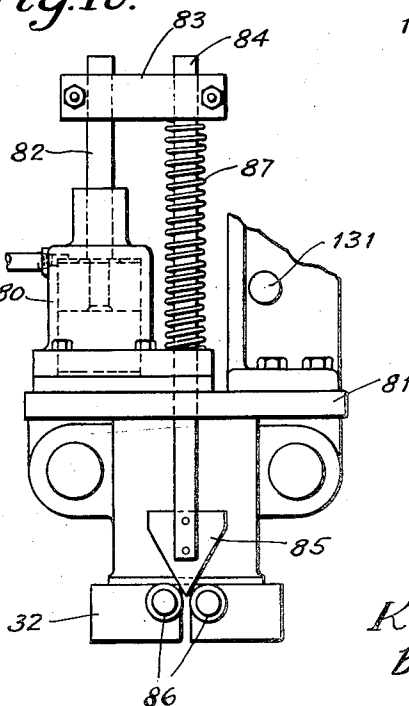
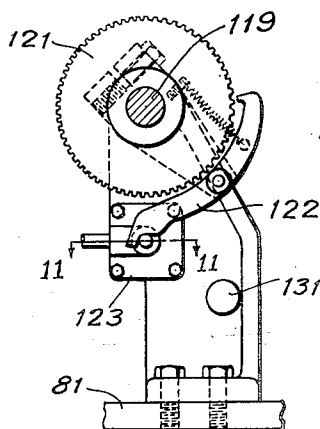


Fig. 9.



Witness:
G. A. Hubert
A. A. Horn

Inventor:
Karl E. Peiler
by Brown & Parkman
Attorneys.

April 24, 1934.

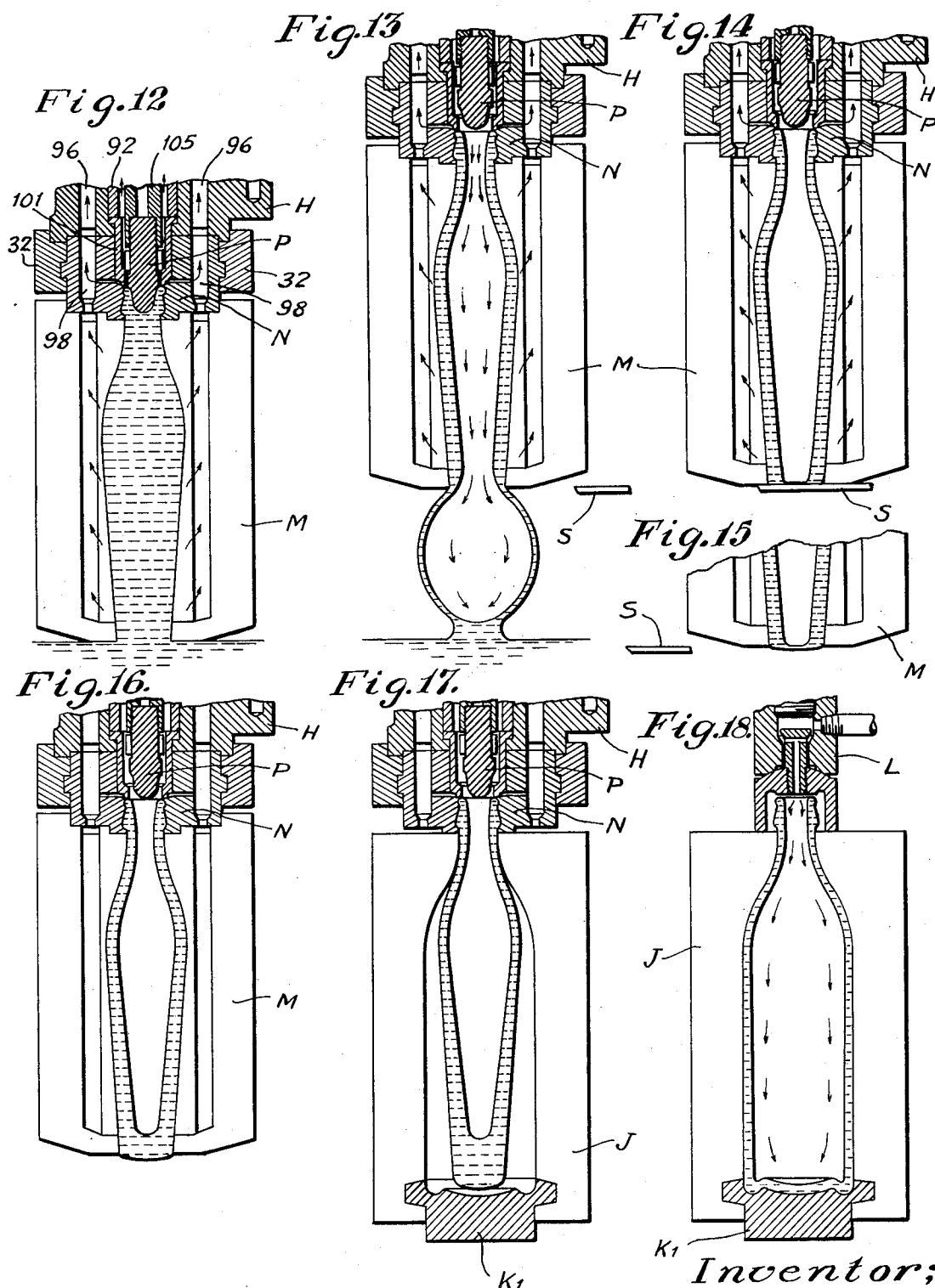
K. E. PEILER

1,955,765

METHOD OF AND APPARATUS FOR FORMING HOLLOW GLASSWARE

Filed Aug. 31, 1931

6 Sheets-Sheet 6



Witness:
G. A. Deberg.
A. A. Horn

Inventor;
Karl E. Peiler
by Brown & Parkman
Attorneys.

UNITED STATES PATENT OFFICE

1,955,765

METHOD OF AND APPARATUS FOR FORM-
ING HOLLOW GLASSWAREKarl E. Peiler, West Hartford, Conn., assignor
to Hartford-Empire Company, Hartford, Conn.,
a corporation of Delaware

Application August 31, 1931, Serial No. 560,428

15 Claims. (Cl. 49—5)

This invention relates to the manufacture of bottles and other containers and similar glassware, by the fill and empty method.

The general object of the invention is to provide a novel method whereby charges of glass are gathered directly from the surface of a gathering pool by suction and formed into hollow parisons in such a manner that finished glassware may be made more efficiently and of better quality than heretofore.

This invention is related to, and is an improvement on, an invention disclosed in the application of George E. Rowe, Serial No. 560,320, filed concurrently herewith, said invention being a method designated as the fill and empty method, according to which hollow bodies or parisons are formed by charging a mold with glass, and thereafter expelling a predetermined amount of glass from the interior of the charge by the application of volumetrically controlled air pressure thereto. Such expulsion of glass forms a large bubble in the charge, terminating within the mold, thereby forming a hollow body closed at its bottom.

It is a particular object of this invention to provide a novel fill and empty method for forming hollow glassware embodying the broad principles of the invention in said application of George E. Rowe, but in which the charges of glass are made hollow by completely expelling a central core of glass from the interior of each charge and from the mold in which the charge is gathered, to leave a substantially tubular body in the mold, the open end of which thereafter is closed to form a hollow body such as a parison. The attainment of this object results in exceptional uniformity in wall thickness of, and/or unusually uniform general distribution of glass in, the finished glassware.

Another object of this invention is to provide a novel method of the above general character wherein a parison can be completed without necessarily applying air pressure to its interior after the severing operation, permitting immediate removal of the knife after severing. This eliminates chilling and resulting blemishes and possible breakage in the finished wear, which occurs in the usual suction process employing "compression on the knife".

It also is an object of this invention to provide a novel method of the above character wherein the lower end of the suction gathered charge is made hollow before it is severed from the bath, and a hollow connection formed between the charge and the bath before severing. This hollow connection may be very thin-walled and be burst to minimize the bubbles on the bath after severing. Because of the thinness of the wall of the connection, it, or the glass of the bubble or bubbles formed therefrom, may be reassimilat-

ed by the glass in the bath much more quickly than the bit or tail of glass of solid cross-section formed in the usual suction process.

A further object of this invention is to provide novel apparatus for performing the novel method.

Other objects of the invention will be pointed out in the detailed description thereof which follows or will become apparent therefrom.

Description of process

The novel fill and empty process of the invention first is described with particular reference to Figs. 12 to 18 inclusive of the accompanying drawings, in which the process is depicted in several typical stages thereof.

As shown in said figures, the instruments employed may, in general, be such as are used in the ordinary suction process. Said instruments may include a parison mold unit and a finishing or blow mold unit. The parison mold unit includes the parison body mold M, the neck mold N, the neck plunger P, the suction and blow head H, and the shear blade S. The finishing mold unit includes the finishing mold J, the bottom plate K1 therefor, and the finish blowhead L.

Such instruments may be embodied in any desired type of automatic glassware forming machine, or may be manually operated.

The procedure which may be followed in practicing the novel process is as follows:

The parison mold M is lowered into contact with a bath of molten glass. Vacuum is then applied and the mold filled with molten glass in the usual manner, as shown in Fig. 12. This parison mold is like the usual parison mold for the Owens suction process, excepting that its interior configuration is such as to make allowance for the hollow parison and for the typical change in thickness of the hollow parison walls between the upper and lower ends, as will presently be explained. In sucking the glass into the parison mold, the plunger or neck pin P forms a preliminary depression in the glass at the upper end of the mold, and if the neck ring N is employed, it shapes the exterior of the neck of the glass above the parison mold M.

The parison mold is raised to a convenient distance above the bath as soon as possible, so as to minimize the heating of the mold by the bath of hot glass. The mold should be raised as soon as it is filled, and may be raised a short time before it is completely filled, depending on its dimensions. The neck plunger P is allowed to remain in contact with the glass a sufficient length of time to set the finish of the bottle properly. During this time, which varies with different types and sizes of ware, the vacuum preferably remains on. The plunger is then withdrawn, vacuum being first disconnected from the space around the plunger, and the glass chilled

by the tip of the plunger is allowed to reheat a proper length of time so that it will be sufficiently plastic for the next step.

After the expiration of a suitable period for such reheat, air under pressure is admitted to the cavity which was formed by the plunger, and the glass forming the central core of the glass in the parison mold is blown out, as shown in Fig. 13. During this blow out period, vacuum may be maintained in the vacuum grooves of the mold, but of course must be disconnected from the space around the neck plunger. The blow out operation is continued until the central portion or core is completely blown out, and so that a bubble protrudes from the lower end of the parison mold, thus forming a hollow connection between the glass in the parison mold and the bath of molten glass.

The object of completely blowing out the central core, until the connection between the parison mold and the bath is hollow, is to avoid excessive variation in the amount of glass in the parison, and hence in the final article.

As soon as the central core has been blown out to the point where the connection between the parison mold and the bath is at least partly hollow, the blowing out pressure is discontinued and the glass between the parison mold and the bath is severed by moving a knife blade S across the lower end of the parison mold. This severing is preferably done with a single knife blade moving in contact with the lower end of the parison mold, although it may be accomplished by means of a pair of blades (not shown) spaced below the parison mold. The blowing out operation is discontinued, preferably just before severing.

After severing, the hollow connection between the parison mold and the bath falls back on the bath, forming a large bubble on its surface. This hollow connection may, if desired, be burst by continuing the blowing out pressure for a sufficient time just prior to severing, so that the greater portion of the air in the hollow connection is released by this bursting, and several smaller bubbles are formed. If this hollow connection is not burst by the blow-out pressure, it will form a single large bubble or blister, which generally bursts after it falls back onto the surface of the bath, and in so doing forms several smaller bubbles. In either event, one or more bubbles or blisters are formed on the surface of the bath as a result of the falling back of the hollow connection, the bursting merely reducing the size of the bubble.

It is necessary to remove these bubbles from the portion of the glass bath where the gathering operation takes place, as sucking up of such bubbles in subsequent charges would form defective charges and defective ware. These bubbles must then be reheated to a sufficient temperature so that they will burst and leave the glass free even from small blisters. For this purpose the surface of the glass at the gathering zone is moved around to a zone of higher temperature where it is properly reheated to a suitable temperature.

The walls of the parison, which are left in place by the operation of blowing out the central core, are tapered in thickness, being thinner above and thicker below. This is due partly to the fact that the glass at the lower end of the parison has been in contact with the mold walls for a longer time than has the glass at the upper end of the parison, and is therefore relatively more chilled below and less chilled above. It is also partly due to the fact that both during and after the blowing out

operation the glass in the walls, which is still plastic, tends to run down or slump under the influence of gravity, thereby becoming gradually thicker at the lower portion and thinner at the upper portion. This tendency is made use of in closing the bottom of the parison after the cutting-off operation, as will be explained later.

In severing by the preferred form, the knife S is preferably left in contact with the glass just as short a time as possible. This is also preferable when severing with a pair of spaced shear blades. To minimize the time during which the single knife blade is in contact with the glass, it may be moved completely across the parison mold cavity, being lowered or moved to one side before returning or being kept out of further contact on or before its return stroke by further lateral or vertical movement of the parison mold. If it is not possible to move the knife in this manner, it should pause under the parison mold as short a time as possible, and should withdraw immediately.

As the knife cuts through the glass, it forms a very thin film of glass, closing the lower end of the parison so that the parison is hollow excepting for this thin film across its lower end. This is illustrated in Figs. 14 and 15. After the cut-off is completed, and after the knife is preferably withdrawn, the glass in the parison walls continues for a short time to run down as previously described, so that the walls become thinner up above and thicker below. This causes additional molten glass to accumulate on the thin film which has been chilled by contact with the shearing surface, and which therefore acts to support this accumulating hot glass. This glass gradually accumulates at the bottom of the parison until it assumes the form shown in Fig. 16 (Fig. 15 shows lower end of parison with shear removed, showing thin film above referred to). The parison is now ready for transfer to the blow mold.

As a result of the immediate withdrawal of the shear blade and the formation of only a thin slightly chilled supporting film closing the lower end of the parison, the hot glass running down onto this thin film, to form the bottom of the parison, reheats the thin film and forms a bottom which is not unduly chilled. This prevents the setting up of strains from chill at the bottom of the parison and results in ware which may be made sufficiently free from strain in the bottom. It is quite common in the ordinary suction process of the Owens type to have the knife cause strains in the bottom of the parison, and subsequently in the finished ware. These strains cause the central portion of the bottom, and sometimes the entire bottom of the ware, to drop out during the annealing of the ware, or may cause the ware to fail by a portion of the bottom or the entire bottom dropping out under pressure in subsequent use. The present process gives a great advantage in this respect in that this weakness is avoided.

Sometimes air is trapped in the parison by the severing operation, which if allowed to remain may be expanded by heat and burst the thin film of glass formed in severing. To prevent this, the interior of the parison may be vented immediately after severing in suitable manner.

It is not necessary to apply pressure while the cut-off knife closes the bottom of the parison mold or to support the glass with a bottom plate in order to set the parison walls properly against the walls of the parison mold. These operations are rendered unnecessary by the fact that the air pressure which blows out the central core of the

gathered mass of glass in the parison mold serves the same purpose. This air pressure is applied very soon after gathering and while the glass forming the parison walls is still extremely plastic. It therefore acts with great efficiency to force the glass into intimate contact with the walls of the parison mold. Moreover, this air pressure may be considerable, and is therefore quite sufficient for this purpose. It is therefore unnecessary to leave the knife under the parison mold for any appreciable period of time or to engage a bottom plate with the bottom of the mold. On the contrary, the knife may be immediately withdrawn, with the various advantages which have been described above.

The finished parison is then transferred to the blow mold J for final blowing into the complete article. This transfer operation is preferably effected by first disengaging the parison mold from the parison, leaving it suspended in the neck ring N; then closing the blow mold about the suspended parison, as shown in Fig. 17, and then disengaging the neck ring from the parison, leaving the parison suspended in the blow mold. A blow head L is then applied over the mouth of the parison in the blow mold and the parison is blown to final form as shown in Fig. 18. However, the parison may be blown to final shape in the blow mold while held by the neck ring, according to the known practice in the art, if desired.

The interior shape of the parison mold M should be suitably made to provide the proper quantity of glass in the final article, making allowance for the amount of glass which is blown out with the central core. It should also be shaped to take account of the thickness of the parison walls, which varies between the upper and lower ends of the parison. The tendency is for the parison walls to be thinner at the top and thicker below, tapering gradually and quite uniformly between the top and the bottom. Allowance should also be made for the fact that a certain amount of the glass in the parison walls runs down into the bottom to form a bottom closure for the parison, which is thicker than the closing film formed by the severing operation. The thickness of the parison walls at any horizontal plane through the parison tends to be quite uniform and therefore to control the distribution of the glass at any such plane in the finished article. The external diameter of the parison at any given plane may be selected or varied to suit the amount of glass or thickness desired in the walls of the final article at this plane. The external diameter of the parison at any horizontal cross section will be greater than that of a corresponding solid parison made by the existing typical suction process, known in the trade as the Owens process. In general, the external contour of a typical parison of my process is shown by the Figures 12 to 17, the parison being of larger diameter at a point between the upper and lower ends than it is at its lower end, although the parison may be made bell-mouthed or flared at its lower end for certain articles, to get more glass in their lower corners. By allowing for these tendencies, the distribution of glass in the final article may be readily controlled. The amount of glass in the finished article may also be controlled by the shape and contents of the parison mold cavity. The amount of glass which is blown out of the central core varies somewhat with the type and size of ware being made, and depends upon the dimensions of the ware, particularly the mouth of

the ware, and upon the relation between the area of its external surface to the cubic contents.

The advantages of my novel fill and empty process over the existing suction process are as follows:

The ware is of better quality and the distribution is under control and is more uniform.

The parison cavity may be made larger and gives more favorable conditions for filling the parison mold.

The greater surface of the parison and its correspondingly thinner section gives a more efficient heat absorption from the parison by the parison mold.

There is less difference in temperature needed between the inside and the outside of the parison.

The parison may be transferred relatively sooner and requires less reheating time before blowing.

The glass requires less time in the blow mold.

As a result, this process is more efficient and produces more articles per mold per minute.

Description of apparatus

The apparatus referred to in the above description of the novel process may be embodied in an automatic machine for carrying out the process. A convenient embodiment of such a machine, in itself novel, is illustrated in the drawings wherein elements corresponding to those shown in Figs. 12 to 18, inclusive, are identified by the same reference characters.

In said drawings:

Figure 1 is a view partly in side elevation and partly in longitudinal vertical section of part of a machine and of a container for a pool of molten glass, by the employment of which the method illustrated in Figs. 12 to 18, inclusive, may be practiced;

Fig. 2 is a partially diagrammatic view in front elevation of the complete machine shown partially in Fig. 1;

Fig. 3 is a view in horizontal sectional top plan of the construction shown in Fig. 2, and taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged detail view in top plan of timing mechanism embodied in the apparatus illustrated in Figs. 1 and 2;

Fig. 5 is a still further enlarged view in central vertical longitudinal section and elevation of the parison mold unit of the apparatus shown in Figs. 1 and 2;

Fig. 6 is a partially diagrammatic fragmentary view in horizontal sectional top plan, taken substantially on the line 6—6 of Figs. 5 and 7;

Figs. 7, 8 and 9 are transverse sectional views of the timing mechanism shown in Fig. 4, and taken respectively on the lines 7—7, 8—8 and 9—9 of said Fig. 4;

Fig. 10 is a view in end elevation of the parison forming mechanism looking from the right in Fig. 2, and showing a neck mold opening device; and

Fig. 11 is an enlarged view in horizontal section of a pawl operating air motor associated with the timing mechanism, said view being taken substantially on the line 11—11 of Fig. 9.

Figures 12 to 18 illustrate the process in several typical stages thereof.

Referring in detail to the drawings:

A pool of glass (Fig. 1) is contained in a forehearth or extension 13 of a glass tank, not shown, but the front wall of which is indicated at 14. The forehearth may comprise a lining 15 of highly refractory material surrounded by insulation 16. In order to assist in the circulation of the

glass, an island 17 of highly refractory material may be positioned in the forehearth to provide a U-shaped channel or passageway (not completely shown), the bend of which provides the gathering pool and in one leg of which may be mounted an impelling implement 18 to provide forced circulation of the glass through the channel. Such an arrangement for circulating glass is disclosed in the patent to Karl E. Peiler, No. 1,721,487, granted July 16, 1929, which also shows mechanism for moving the impeller in a vertical rectangular path as indicated by the arrows at 19, or otherwise, while the implement constantly is maintained in contact with the glass. The implement may be moved at a greater speed in one horizontal direction than in the other, to cause a circulation of the glass through the pool at the required velocity and in the required manner to remove from the pool chilled bits of glass and chilled spots and/or bubbles produced by the gathering, blow-out, and severing operations. Such glass may thus be carried inwardly of the forehearth for reheating and for reassimilation with the other glass in the pool.

The glass in the forehearth may be partially enclosed by means of the cover construction 20, through which the stirring implement 18 projects. That permits heat to be applied to the rear portion of the forehearth to recondition glass therein, as described above.

The parison mold unit, which comprises the suction and blow head H, neck mold N, and neck pin P, Figs. 1 and 5, may be carried by a column 21, Figs. 1, 2 and 3, journaled intermediate its ends in a block 22, Fig. 1, secured to and extending rearwardly from the top of a channel iron 23, the bottom of which is secured to a bearing 24, mounted on base 25, and through which bearing and base the bottom portion of the column 21 extends.

Secured to the top of column 21 is a bracket 26. The horizontal portion 27 of the bracket carries a pair of rods, one of which is shown at 28, to the ends of which rods a casting 29, Figs. 1, 2 and 5 is secured. As shown particularly in Fig. 5, the suction and blow head H is formed integrally with the casting 29, and said casting is bored to receive a pivot bolt 31 upon which the holders 32 for the sections of neck mold N, and the holders 33 for the sections of the body mold M, are swingably mounted. See also Figs. 1 and 2. The details of the head H and the mechanism for operating the neck mold N and the body mold M are later explained.

The column 21 is so mounted that it may be lowered and raised to move the body mold M into and out of contact with the surface of pool G, and when in its raised position, to be swung through an angle of approximately 90° in a clockwise direction into a position where the finishing mold J is located, as shown in Figs. 2 and 3. In that position, a parison is transferred to the finishing mold J, after which the column may be raised slightly and then rotated in the opposite direction again to position the parison forming unit above the pool G.

The mechanism for raising and lowering the column and parts carried thereby and for swinging the column now is described.

Secured to the column 21 is a collar bearing 34, Fig. 1 with which cooperates a collar 35, suitable anti-friction bearings being interposed between the two collars. Collar 35 which carries the weight of column 21 and parts mounted thereon, is supported upon links, one of which is

shown at 36, connected at their bottom ends to the end of a lever 37 pivoted intermediate its ends at 38 on the base 25. A series of openings 39 may be formed in the inner end of lever 37 for changing the connections of links 36 therewith and thereby varying the vertical stroke of column 21.

As shown in Figs. 1 and 2, the outer end of lever 37 carries a roller 41 which bears against the cam disc 42 adjustably secured to a hub 43 fast on a horizontal shaft 44.

Looking at Fig. 2, it will be seen that shaft 44 is journaled at its right-hand end in a vertical bracket 45 and that said shaft extends to the left through the spaced vertical pedestals 46 and 47 of a U-shaped bracket 48 on base 25. On its right-hand end, looking at Fig. 2, shaft 44 carries a gear 49 in mesh with a pinion 50 of suitable speed reduction mechanism 51 which may be driven by a motor 52. The driving connections thus provided for shaft 44 may serve to rotate it and cam 42 in a counterclockwise direction looking at Fig. 1.

Mounted on shaft 44 between the vertical arms of bracket 48 is a drum 53 of a timer designated generally at T. Drum 53 may carry buttons adjustably secured to the periphery thereof for operating valves not shown, in a valve chest 54 for controlling the distribution of air pressure to various parts of the machine, in response to the rotation of shaft 44. The construction of timer T may be substantially the same as that shown in British Patent No. 257,637 granted to the Hartford-Empire Co.

Returning to the description of the mechanism for operating the column 21, and referring particularly to Fig. 1, it will be seen that cam 42 acts on lever 37 to raise and lower column 21 and the parison mold unit carried thereby. In the position in which the parts are shown in Fig. 1, the parison mold unit is in its uppermost position above the gathering pool, being so held by the terminal end portion of the high part 56 of cam 42. As cam 42 continues to rotate in a counterclockwise direction, roller 41 rides in a recess 57 of the cam as a result of which the mold unit is lowered to dip the bottom of the parison body mold M in the gathering pool where it is held for the desired time by a concentric dwell portion 58 of the cam. While so held in lowermost position, the parison mold unit is charged with glass after which the roller 41 is lowered by the projecting cam portion 59, then onto a concentric dwell portion 60 which holds the mold unit in a position for the glass depending from the charge in the mold to be severed by the shear blade S (Fig. 1). Upon completion of the severing operation, roller 41 is engaged by the advanced end portion of high part 61 of cam 42 to raise the glass in the mold from off of the shears and to position the mold unit in its uppermost position in readiness to be swung to the finish blowing station without, however, permitting the shear S to touch the bottom of the charge in the mold.

When the parison mold unit has delivered a parison to the finishing mold J, a lobe 62 on cam 42 causes the unit to be raised so that the neck mold N will clear the top of the parison in the finishing mold when the mold unit is to swing back to its gathering position.

For rotating the column 21 and the parison mold unit, a crank arm 64, Figs. 1 and 2, is secured to the bottom end of the column, to which crank arm the inner end of a link 65 is jointed

by a ball and socket connection 66. At its outer end, link 65 is connected by a ball and socket connection to the bottom end of a lever 67 pivoted at its upper end in the tops of the bracket 45 and the pedestal 46 by means of a rock shaft 68 to which the lever is secured. Lever 67 carries a roller 69 which is held in position for engagement by a cam disc 70 adjustably secured to a hub 71 fast on shaft 44.

Thus cam 70 oscillates the parison mold unit horizontally from the gathering position to the finish blowing station and returns the parison mold unit to the gathering station, at appropriate or desired times.

The adjustable mountings of cams 42 and 70 permit the times of raising and lowering and swinging of the parison mold unit to be varied to suit varying glass working requirements.

The parison body mold is operated by means of an air motor 73, Figs. 1, 2 and 3, secured to the vertical portion 74 of bracket 26. The rod of air motor 73 is connected to links 74a which in turn are joined to levers 75 pivoted on the horizontal portion 27 of bracket 26, and in turn connected by links 76 to the holders 33 of the parison body mold M. Air is admitted to and exhausted from the opposite ends of air motor 73 through conduits 77 and 78 which lead from the timer T, to open and close the mold at the appropriate times. Thus, the parison body mold is opened at the finish blowing station and is closed at least by the time that the parison mold unit is returned to the gathering position.

The neck mold N carried by the holders 32 normally yieldingly is held closed by a tension spring 32a, Fig. 5. However, the neck mold or neck ring is opened at the finish blowing station to release a parison therefrom by the operation of an air motor 80, Figs. 2, 4 and 10. Air motor 80 is mounted on the outer end portion of a base 81 supporting timing mechanism T1 and parts operated thereby, said base resting upon and being secured to, the horizontal portion 27 of bracket 26 and to the casting 29.

Referring to Fig. 10, it will be seen that the rod 82 of air motor 80 carries a cross head 83 to which is connected a vertical rod 84 extending downwardly through base 81 and carrying a wedge 85 adapted to enter between lugs 86 on the neck mold holders 32. Rod 84 and wedge 85 normally are held in inoperative position by a compression spring 87 and are moved downwardly to open the neck ring by the admission of air pressure to the upper end of motor 80 through a conduit 88 which, as shown in Fig. 2, leads from the timer T.

The details of construction of the parison forming unit including the suction and blow head H, mechanism for operating the neck pin P, and passageways and valve mechanism for the introduction of air or vacuum into the molds of the unit, now are described.

The general construction of the parison mold unit best is shown in Fig. 5. The head H has an outer vacuum chamber 90, and an inner vacuum and pressure chamber 91 separated from chamber 90 by a sleeve 92 mounted in the head, as shown.

Also mounted in the head H is a valve casing 93, Figs. 1, 2, 4 and 5, having a vacuum inlet pipe 94, Figs. 6 and 7, and containing a poppet valve 95 which controls the admission of vacuum to chamber 90.

Leading downwardly from the chamber 90 are vertical ducts 96 which open into an annular

chamber 97 with which chamber ducts 98 in the sections of the neck ring N register when the neck ring is closed. Suitable passages lead off of the ducts 98 to the top of the neck finish portion of the neck mold for applying vacuum thereto, and the bottoms of said ducts are placed in communication with similar vertical ducts 99 in the sections of the body mold M from which ducts vacuum is applied to the mold cavity through the joint of the mold when the mold is closed.

The bottom end of sleeve 92 which provides the chamber 91, previously referred to, bears against the top of a nipple 101, supported in the head H, and providing an opening 102 into and out of which the neck pin P is projected and withdrawn to more or less restrict, or to unobstruct the said opening.

Vacuum is applied to the chamber 91 and hence to the interior of the neck and body molds to assist in charging the molds with glass, through a vacuum inlet casing 103, Figs. 1, 6 and 7, under the control of the poppet valve member 104.

The neck pin P, is screw-threaded into the bottom end of a plunger 105 slidably mounted in the sleeve 92 for vertical reciprocation in the chamber 91.

Plunger 105 is closed at its upper end by a cap 106, Figs. 2, 5 and 7, connected for lost motion to the top of the plunger by pins 107, the inner ends of which engage slots 260, formed in the plunger. The cap and plunger yieldingly are urged apart by a compression spring 108. Mechanism later described is connected to cap 106 to reciprocate the plunger 105, and thus to yieldingly hold the neck pin P seated or in retracted position at desired times.

After the neck pin P has been retracted, (and inside vacuum valve 104 closed), air under pressure may be admitted to chamber 91 through a conduit 108, Figs. 4, 5 and 8, which leads from an air supply piston valve 109 on base 81, having an inlet duct 110. Such air pressure serves to blow out the hot central core of a charge of glass as illustrated in Fig. 13.

After the blow out and severing operations, it may be desirable to vent air which may be trapped in the hollow body (Figs. 14 and 15) to prevent such air from bursting the thin bottom of the body. To this end, conduit 108 also is connected by conduit 111, Figs. 4 and 8, to a vent valve 112 on base 81, and having an exhaust pipe 113.

The operation of the neck pin, and of the air, vacuum supply and vent devices, occur in predetermined order under the control of the timing mechanism T1, associated with the parison forming unit. The operative effect of the timing mechanism T1 in turn is controlled by timer T.

The timer T1 comprises a suitable electric motor 115, Figs. 1 and 2, on the top of bracket 26, said motor driving a chain which passes around a sprocket wheel 116. Wheel 116 is mounted on worm shaft 117, Figs. 1 and 4, which drives worm gear 118 loosely mounted on cam shaft 119 extending longitudinally of, and suitably journaled in brackets on, the base 81.

Cam shaft 119 is preferably intermittently rotated from worm gear 118 by pawl and ratchet mechanism indicated at 121, in Figs. 1, 4 and 9, for providing a driving connection between motor 115 and cam shaft 119. The pawl 122 of said mechanism is tripped out of engagement with its ratchet at desired times by means of a spring-pressed and

fluid pressure operated detent indicated generally at 123, Figs. 1, 4, 9 and 11.

The detent is moved to inoperative position to permit motor 115 to drive cam shaft 119 for the desired periods of time, by the admission of air pressure thereto through a conduit 123, which as shown in Fig. 2 leads from the timer T. Upon exhaust of fluid pressure through conduit 123 and the timer, the detent is moved into operative position, tripping the pawl 122 out of engagement with its ratchet wheel, thereby stopping the rotation of the cam shaft. Thus it will be seen that the times at which the cam shaft is rotated and the angular rotation of the cam shaft, may be variably controlled from the timer T.

Cam shaft 119 carries a cam 125, Figs. 1, 2, 4 and 7, for operating the neck pin P; a cam 126 for operating the inside vacuum valve 104; a cam 127 (Figs. 4 and 8) for operating the outside vacuum valve 95; a cam 128 for operating the empty or expelling air supply valve 109; and a cam 129 for operating the vent valve 112.

Each of the cams 125 to 129 may be made in two parts (Fig. 4) one part of which may be fastened to shaft 119 by a set screw and the other part of which may be adjustably secured to the first part to vary the length of the cam edge and thus change the times of beginning and ending at which the particular mechanism controlled by the cam is operated and/or the period of operation. By means of the set screws, each cam may be adjusted as a whole relative to the cam shaft to vary the times of beginning and ending of operation of the device which the cams control.

Motion is transmitted from the various cams to effect a complete cycle of operations, preferably during a single rotation of the cam shaft through 360°, in a counterclockwise direction, looking at Figs. 4, 7 and 8.

Motion is transmitted from cam 125 to the neck pin P through a bell crank 130 loose on a shaft 131 suitably mounted on base 81. See Figs. 1, 2, 4 and 7. The lower arm of a bell crank 130 is connected by links 132, Fig. 7, to the cap 106 on the top of plunger 105, said links being pivoted on the outer ends of pins 107, previously referred to. The upwardly extending arm of bell crank 130 carries a roller 133 which engages the cam 125.

Similarly, motion is transmitted from cam 126 to inside vacuum valve 104 through a bell crank 134, Figs. 1, 4 and 7, the downwardly extending arm of which has an adjustable connection with the stem of valve 104 (as shown), its other laterally extending arm carrying a cam roller 135 which rides on cam 126.

A bell crank 136 loose on the shaft 131, and which includes an upwardly extending arm carrying cam roller 137, Figs. 1, 2, 4 and 8, and a laterally extending arm which carries a screw bolt 138 adjustable therein, (Fig. 5) serves to transmit motion from cam 127 to outside vacuum valve 95.

Cam 128 is engaged by a roller 140 on a bell crank 141 on shaft 131, Figs. 1, 2, 4 and 8, which bell crank is suitably connected to air supply valve 109.

Likewise cam 129 operates a lever 142 on shaft 131 carrying cam roller 143 on its upper end, and connected at its lower end to rod 144, of the movable valve member of vent valve 112.

The glass severing mechanism includes blade S oscillated by means of an air motor 145, Figs. 1 and 3, to and from the ends of which air pressure is admitted and exhausted through conduits 146 and 147 which, as shown in Fig. 2, lead from

the timer T. The blade S may be suitably mounted in holder 148, on vertical rock shaft 149 suitably journaled in a bearing member 151 secured to the rear side of block 22. Rock shaft 149 carries crank arm 152 on its bottom end, connected by link 153 to a cross head 154 on the rod of air motor 155. See Figs. 1 and 3. Thus reciprocation of the air motor under control of timer T serves to swing the shear blade to effect a severing operation as indicated in Fig. 3 preferably at the time that the parison mold unit is held in shearing position by cam 42, as previously explained.

The single shear blade may be replaced by a double shear blade mechanism of known type, if desired.

The finishing mold J is of the sectional type, the sections of which are carried by holders 157, Figs. 2 and 3, pivoted at 158 on a bracket 159 carried by a channel iron 160 secured to the base 25. Pivotaly connected to the holders 157 is a cross head 161 reciprocated to open and close the mold J by an air motor 162 to which air is supplied and from which it is exhausted by conduits 163 and 164 leading from timer T.

A bottom closure K1 is provided for the finishing mold, said closure being mounted on an arm 165 pivoted at 166 and held in the path of a push rod 167 mounted in the depending portion 168 of cross head 169 of the finishing mold mechanism so that operations of air motor 162 serve to raise the bottom closure K1 into a position to be enclosed by the finishing mold J, and to lower the bottom closure into the position in which it is shown in Fig. 2 as the finishing mold is opened, for the discharge of a finished article of glassware.

A blow head L also may be associated with the finishing mold J. Said blow head may be of the similar construction, and operated by mechanism similar to that shown in British Patent No. 257,637, previously referred to, for operating the blow heads in the patent. The blow head mechanism which includes an air motor 171 is mounted in bracket 172, extending from bracket 159 of the mold mechanism.

Admission and exhaust of air to and from air motor 171, through conduits 173 and 174 connected to timer T serves to swing blowhead L downwardly and upwardly into and out of engagement with the finishing mold at appropriate times. Blowing air is supplied to the blow head through conduit 175 which leads thereto from a suitable source, not shown.

The operation of the above described apparatus may be as follows:

The parison mold unit is swung over the gathering pool by the action of cam 70, and dipped into the glass under control of cam 42. Vacuum is applied to the mold cavities through outside chamber 90 by the operation of valve 95 (Fig. 5) and through inside chamber 91 by the operation of valve 104 (Figs. 6 and 7), said valves being operated respectively by cams 126 and 127 (Figs. 1, 2 and 4). Thus the mold unit is charged with glass (Fig. 12). Cam 42 then raises the mold unit to the shearing level, predetermined by portion 60 of said cam. After the neck finish of the glass is set, and inside vacuum valve 104 closed by cam 126, neck pin P is withdrawn by cam 125. The proper period for reheating the glass chilled by the neck pin having elapsed, valve 109 is opened by cam 128. This admits air to inside chamber 91 to blow out the central core of the charge of glass. Up to this time, outside vacuum valve 95 may remain open but now may

be closed by its cam 127. The blowing out operation has been sufficiently explained above with reference to Fig. 13. After the expulsion of glass, shear blade S is operated by air motor 145 in the manner indicated for example in Figs. 14, 15, and Fig. 3.

Immediately following the severing operation, vent valve 112 is opened by cam 129, to exhaust any air which may have been trapped in the hollow parison by the severing action of blade S which, as previously explained, forms a film on the bottom of the hollow glass. At the earliest time practicable the upward movement of the mold unit is completed by lobe 61 on cam 42, to clear the shear blade and prevent smearing the bottom of the glass in the mold.

During the movement of the parison mold unit to the transfer position, effected by cam 70, the bottom of the parison may be thickened somewhat by the downward flow of glass from the side walls of the parison, as previously explained with reference to Fig. 16. The suspended parison now is enclosed by the finishing mold J (operated by air motor 162) and blown to final form therein by the supply of air through blow head L, moved into engagement with blow mold J by the operation of air motor 171.

Prior to the application of finish blowing air, the parison may be held in the finishing mold for a period of reheating, if sufficient reheating has not occurred by the time the finishing mold closes about the parison, and for the additional purpose of further thickening the bottom of the parison. However, this may not be necessary.

It will be understood that the proper and desired control of the parison formation and the finish blowing thereof may be obtained by appropriate adjustment of timers T and T1, or parts thereof, and of the other parts of the apparatus, in accordance with principles set forth in the above description of the novel process of the invention.

The above described embodiments of the invention, may be varied widely both as to the details of the method and the character of the apparatus employed. For example, instead of employing the apparatus shown in Figs. 1 to 11, inclusive, a one or two table rotary machine, may be used as also may a straight line machine of the character disclosed in the copending application of Algy J. Smith, Serial No. 479,676, filed Sept. 4, 1930, provided of course, that such machines are modified according to the novel principles herein disclosed.

Having thus described my invention, what I desire to claim and secure by Letters Patent is:

1. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, expelling sufficient glass forming the interior of the charge from the mold to leave therein a hollow body open at the bottom of the mold, disconnecting the hollow body from the glass in the pool and closing the bottom of the hollow body.

2. The method of forming hollow glass parisons which comprises, forming a charge of glass by gathering glass in a neck mold and parison mold from the surface of a gathering pool by suction, expelling sufficient glass forming the interior of the charge from the mold to leave in the molds a hollow body open at its bottom, and subsequently closing the bottom of the hollow body and disconnecting the hollow body in the mold from the glass in the pool.

3. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, expelling sufficient glass forming the interior of the charge from the mold to leave therein a hollow body open at its bottom, and substantially closing the bottom of the hollow body by severing therefrom the glass connecting the body and the glass in the pool.

4. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, applying blowing air to the charge at least until a central core thereof is expelled from the mold and a bubble of glass is formed connecting glass remaining in the mold with the glass in the pool, and simultaneously disconnecting the hollow body and the bubble of glass and closing the bottom of the hollow body.

5. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, applying blowing air to the charge at least until a central core of the charge is expelled from the mold, and a bubble of glass is formed connecting the glass remaining in the mold with the glass in the pool, and disconnecting the bubble from the glass in the mold and substantially closing the open bottom of the glass in the mold.

6. The method of forming hollow glass parisons which comprises, forming a charge of glass by gathering glass in a neck mold and parison mold from the surface of a gathering pool by suction, forming an initial blowing cavity in the top of the charge, introducing sufficient blowing air into the cavity to expel a central core of the charge from the mold and to leave in the mold a hollow tubular body open at its top and also open where the bottom of the mold terminates, severing the charge from the glass in the pool, and forming a bottom on the hollow body.

7. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, forming an initial blowing cavity in the top of the charge, introducing sufficient blowing air into the cavity to expel a central core of the charge from the mold and to leave a tubular body therein, and closing the open bottom of the tubular body and severing the glass in the mold from that in the pool.

8. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, expelling sufficient glass forming the interior of the charge from the mold to leave therein a hollow body open at its bottom end, closing the open bottom end of the body to form a bottom therefor, severing the glass in the mold from that in the pool, and thickening the bottom of the body with glass from the sides of the body.

9. The method of forming hollow glassware which comprises, forming a charge of glass by gathering glass in a mold from the surface of a gathering pool by suction, providing an initial blowing cavity in the charge, applying sufficient air to the cavity to expel a central core of the charge from the mold, leaving a tubular body of glass in the mold, and continuing the application of air for a sufficient period of time to form a bubble connecting the body in the mold

- and the glass in the pool, severing the bubble from the body and at the same time bursting the bubble and forming a bottom on the tubular body, thickening said bottom with glass from the interior side walls of the body and thus decreasing the thickness of said side walls, transferring the hollow body thus formed to a blow mold, and blowing it to final shape in the blow mold.
10. The method of forming hollow glassware which comprises forming glass into a substantially solid body for a parison having a tapered lower portion, expelling sufficient glass from within the body to make the body hollow and to leave an opening in the end of the tapered portion thereof, severing the expelled glass from the body, closing said opening in the body, transferring the hollow body thus formed to a finishing mold, and blowing the parison to final shape in the finishing mold.
11. A method according to claim 10 wherein the severing operation and the closing of the opening in the hollow body are performed simultaneously.
12. Apparatus for forming hollow glassware comprising a suction parison mold open at its bottom, means for charging said mold with glass from the surface of a gathering pool, means for forming an initial blowing cavity in the top of the charge, means operable while the bottom of the glass in the mold is unsupported for applying sufficient blowing air to the cavity in the charge to discharge from the mold a substantially full-length central core of the charge, to leave a tubular body in the mold, and means for thereafter severing the tubular body in the mold from the glass in the pool and for substantially closing the open bottom of the said tubular body.
13. Apparatus for forming hollow glassware comprising a suction parison mold, said mold having a cavity therein larger in cross sectional area between its upper and lower ends than at its lower end, means for charging said mold with glass from the surface of a gathering pool, means for applying sufficient blowing air to the charge to expel a substantially full length core thereof from the mold, to leave a substantially tubular body therein, means for severing the expelled glass from the body remaining in the mold, and for closing the bottom end of the substantially tubular body.
14. The method of forming hollow glass parisons which comprises forming a charge of glass in a neck mold and parison mold by gathering glass therein by suction, expelling sufficient glass forming the interior of the charge from the mold to leave in the mold a hollow body open at its bottom, severing the expelled glass from the hollow body, closing the bottom of the hollow body, and thickening the lower walls of the hollow body with glass from the upper walls thereof.
15. The method of forming hollow glass parisons which comprises forming a charge of glass in a neck mold and parison mold by gathering glass therein by suction, expelling sufficient glass forming a central core of the charge to leave in the mold a hollow body open at its bottom, severing the expelled glass from the hollow body, closing the bottom of the body, the walls of the body thus formed being thinner above and thicker below, and thickening the lower walls of the hollow body with glass from the upper walls thereof.
- KARL E. PETLER.