No. 744,007. PATENTED NOV. 10, 1903.

J. PROEGER.

MANUFACTURE OF GLASSWARE.

APPLICATION FILED APR. 1, 1902.

NO MODEL. 8 SHEETS—SHEET 1.

Fig. 1.

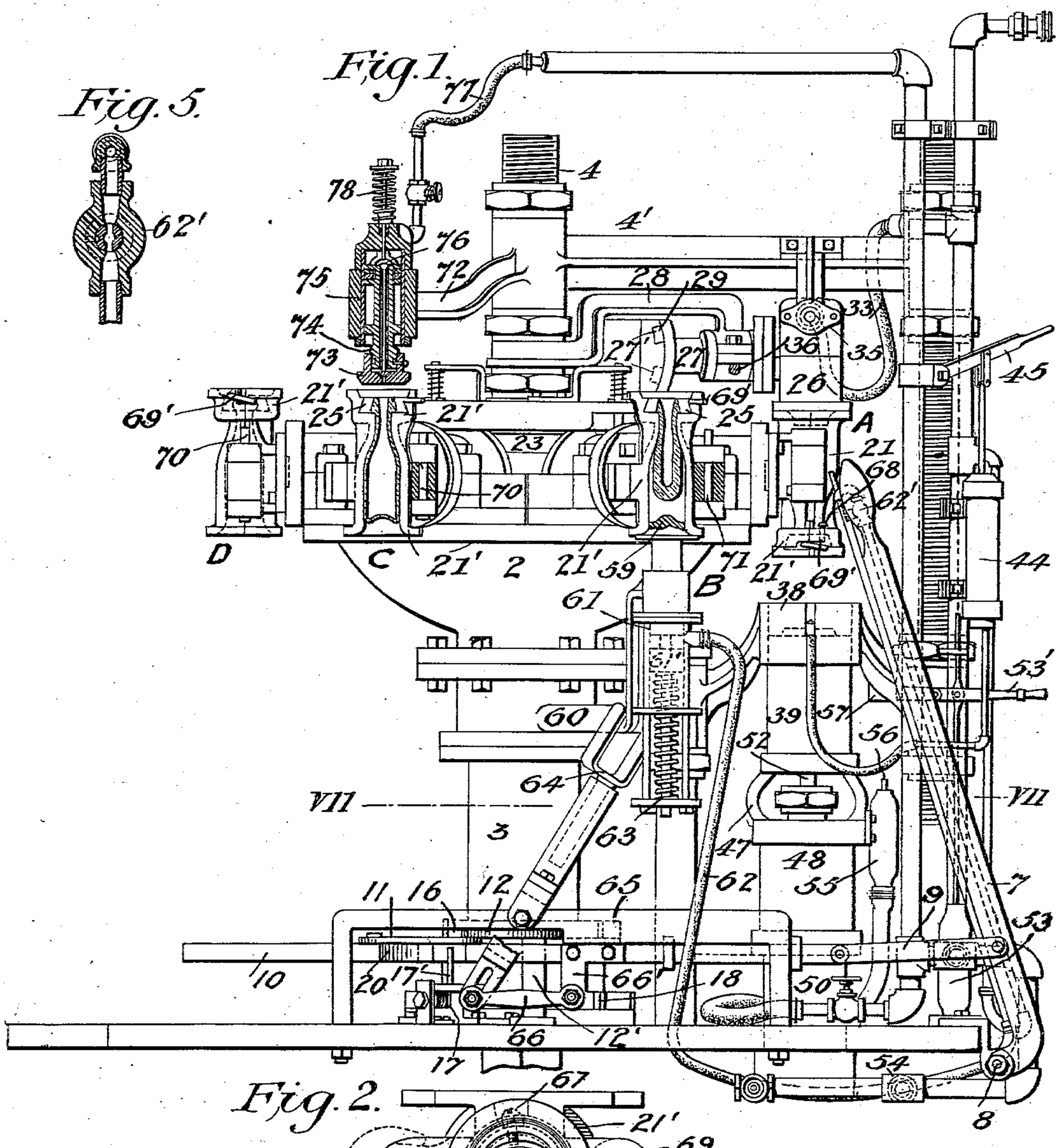


Fig. 5.

Fig. 2.

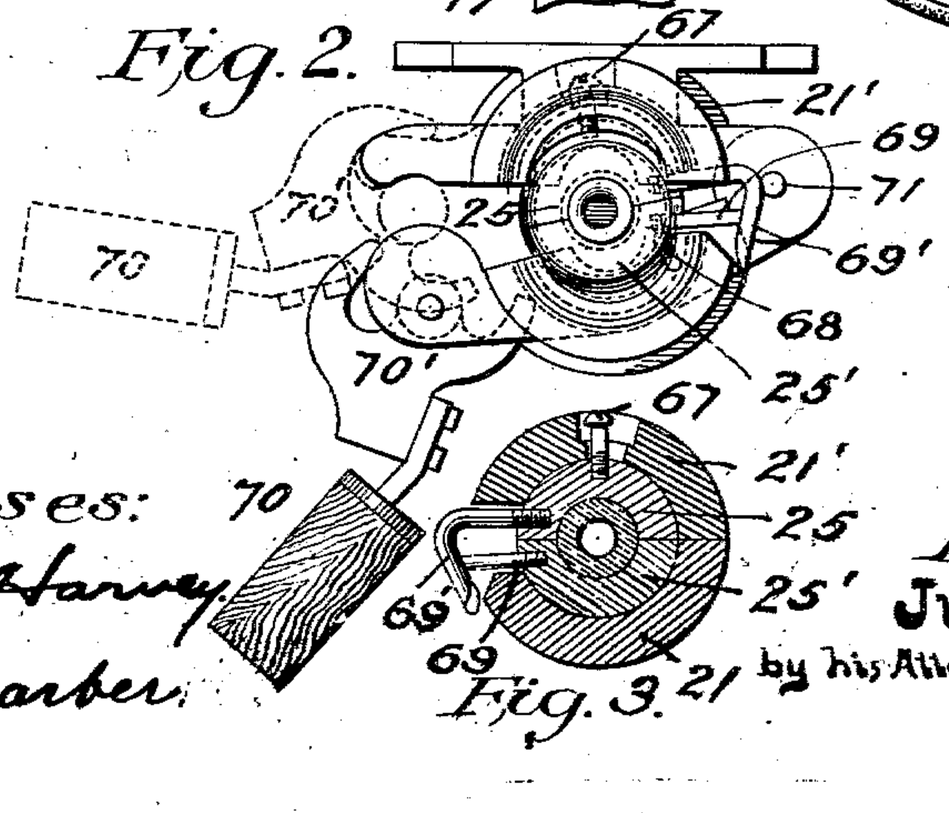
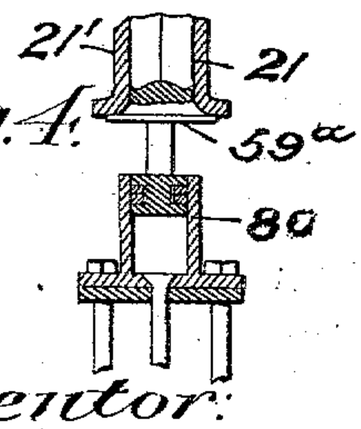


Fig. 3.

Fig. 4.



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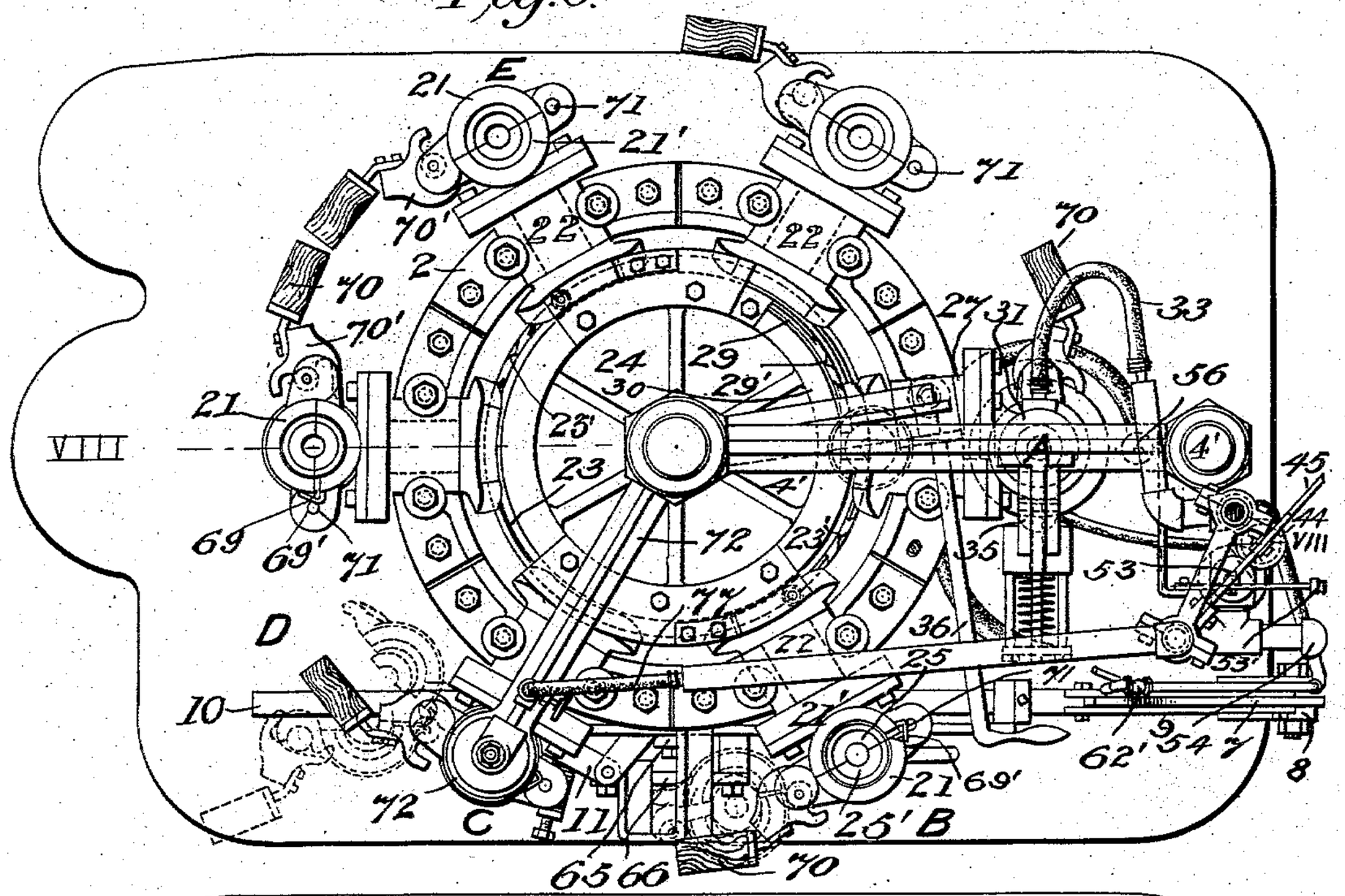
NO MODEL. 8 SHEETS—SHEET 2.

Fig. 6.



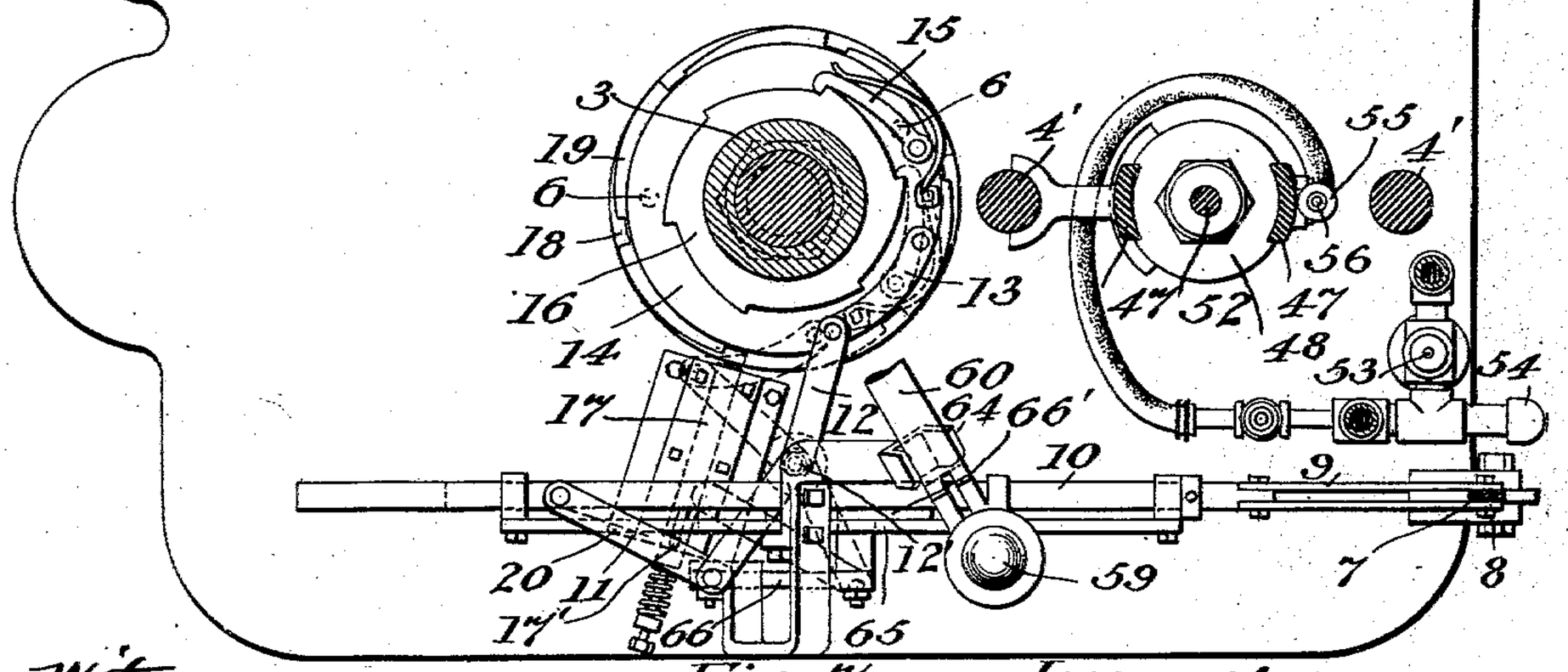


Fig. 7.

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NO MODEL. 8 SHEETS—SHEET 3.

Fig. 9.

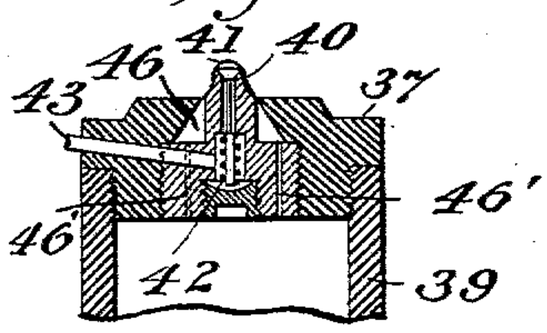
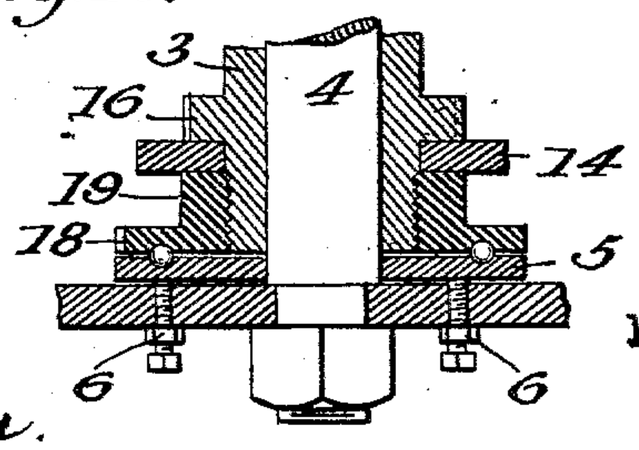


Fig. 8.

Fig. 10.



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NO MODEL. 8 SHEETS—SHEET 4.

Fig. 11.

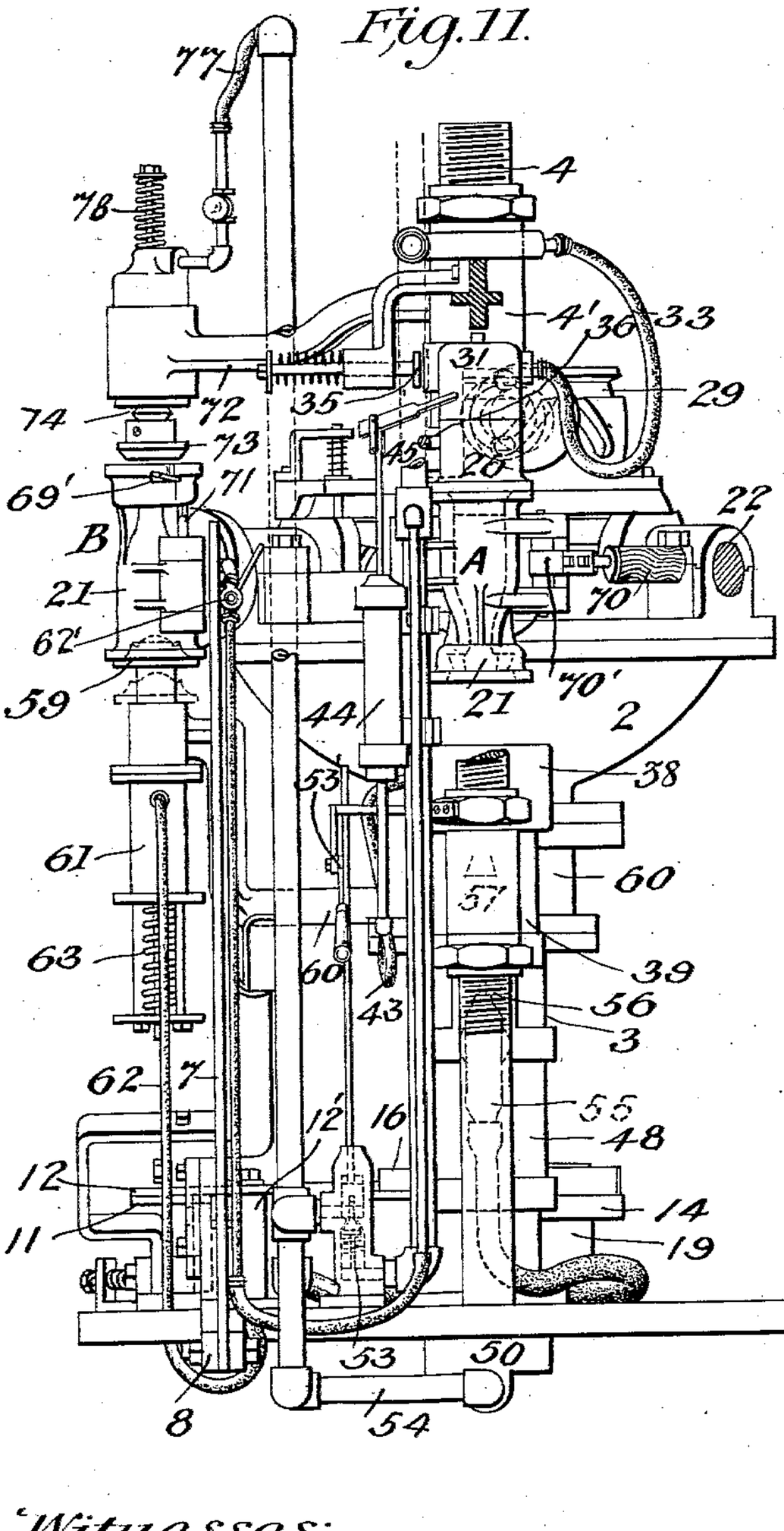


Fig. 12.

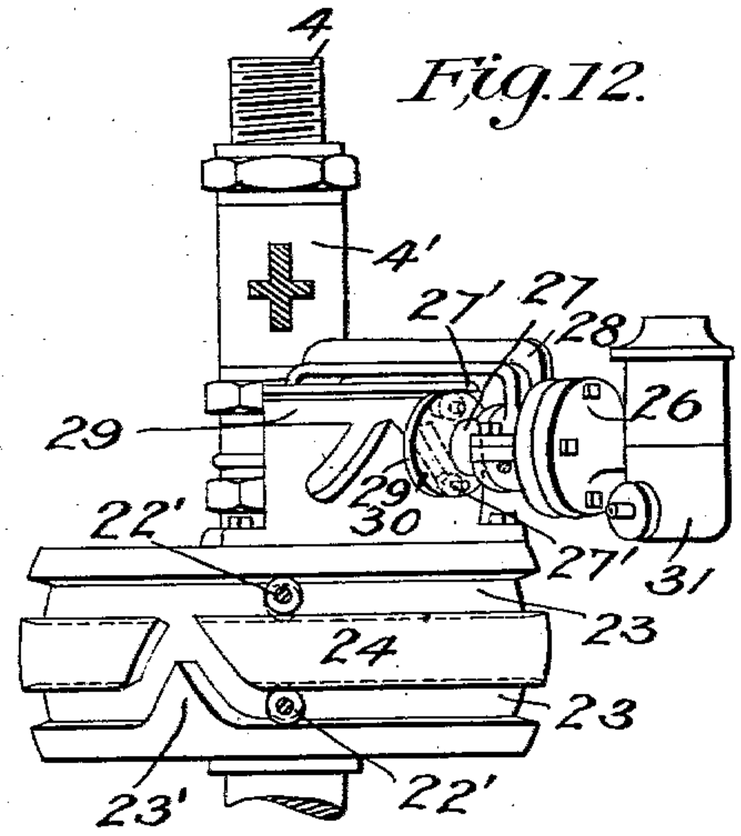
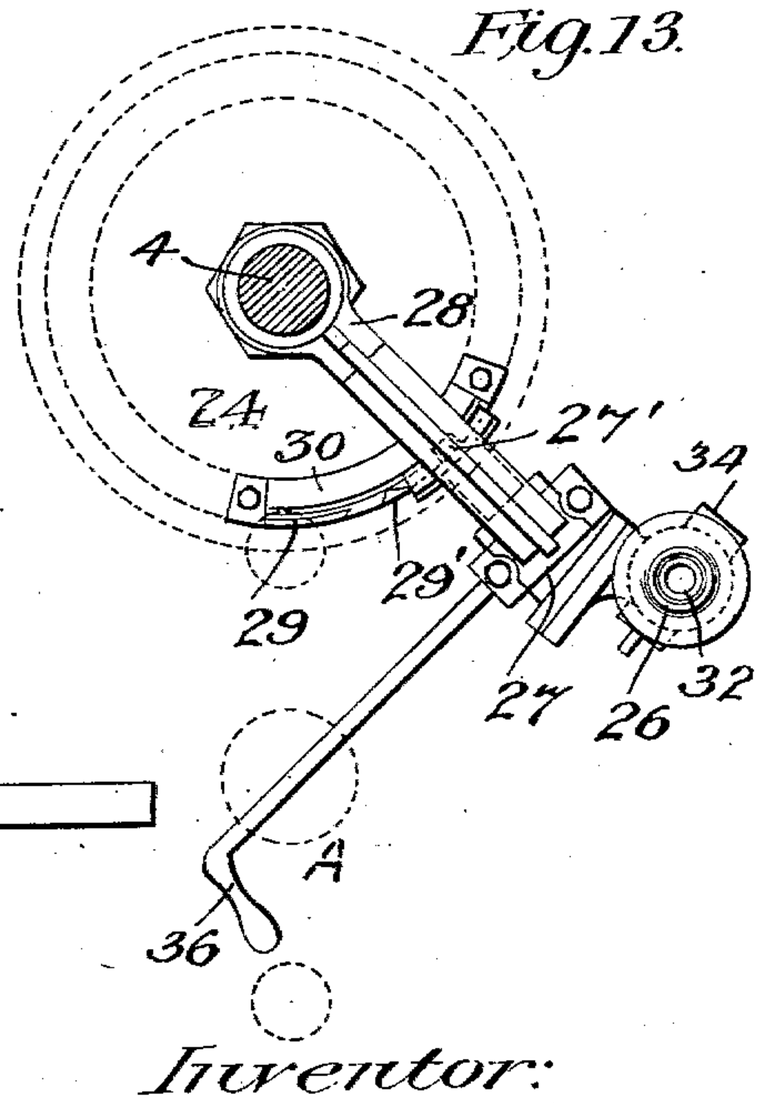


Fig. 13.



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NO MODEL. 8 SHEETS—SHEET 5.

Fig. 14.

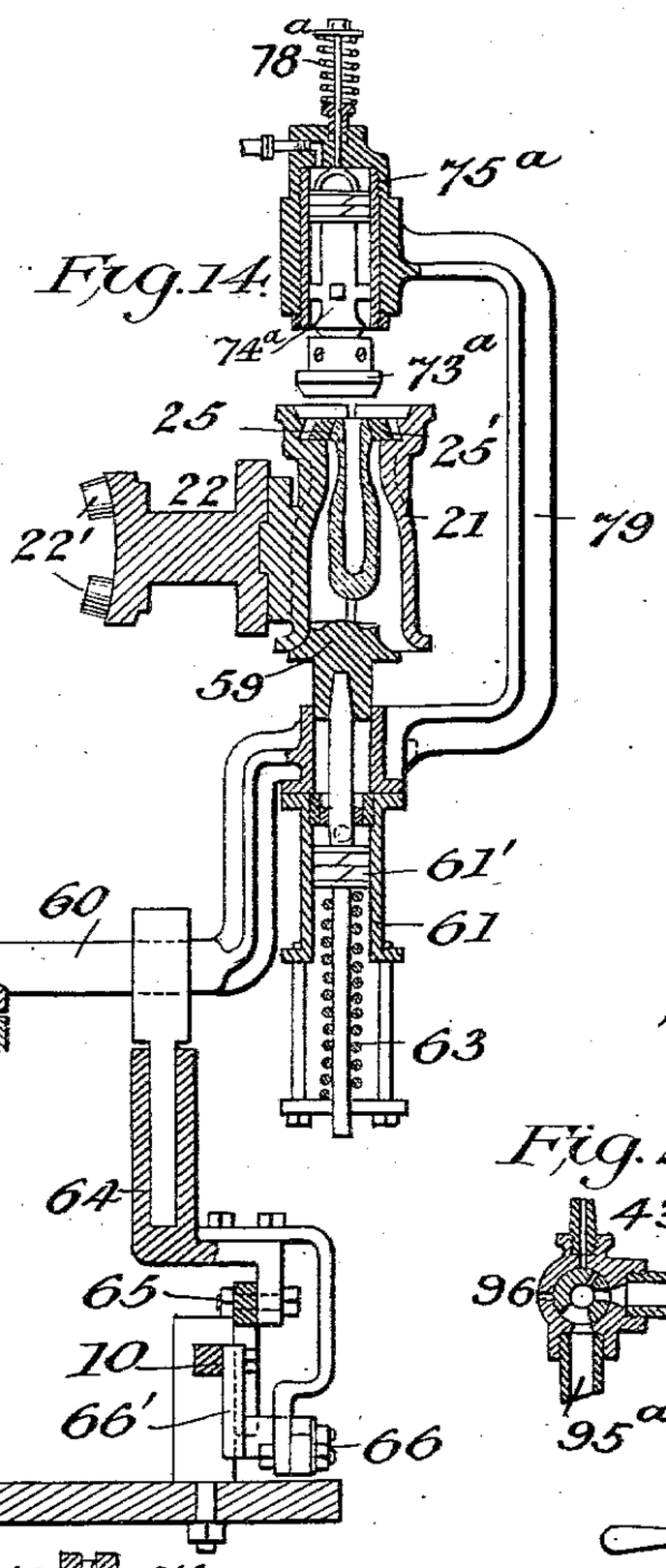

Fig. 17.

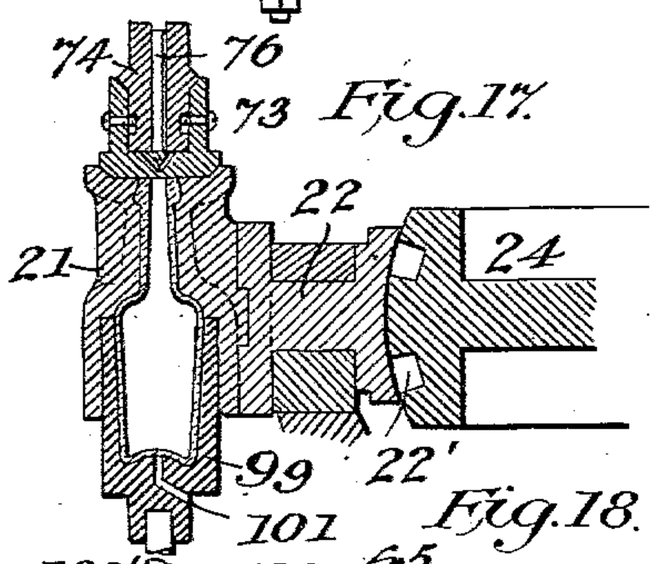

Fig. 15.

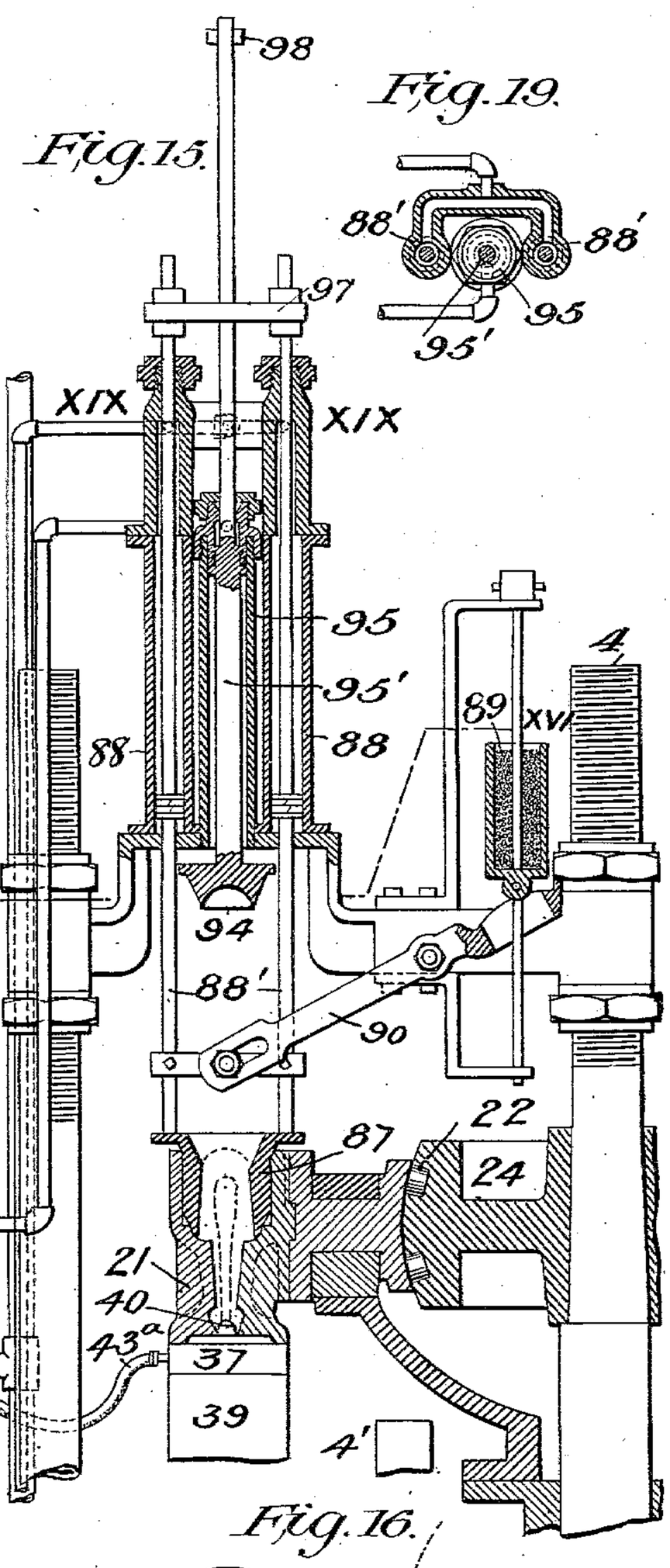

Fig. 19.

Fig. 20.

Fig. 16.

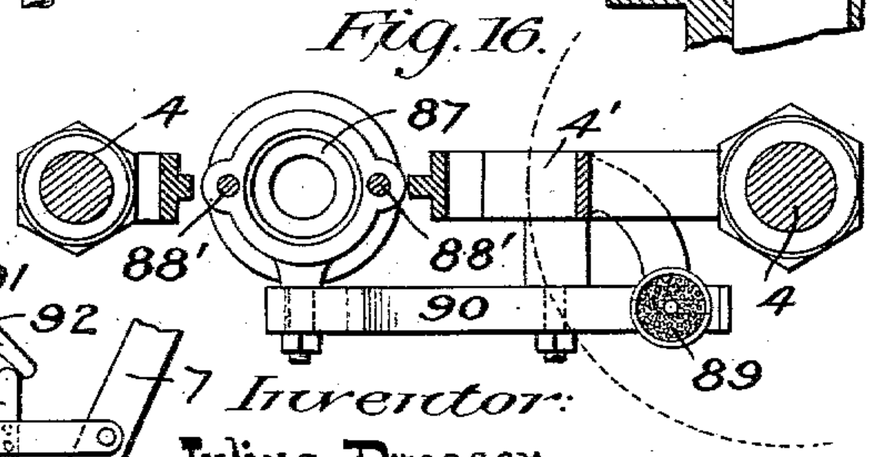

Fig. 18.

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NO MODEL. 8 SHEETS—SHEET 6.

Fig. 21.

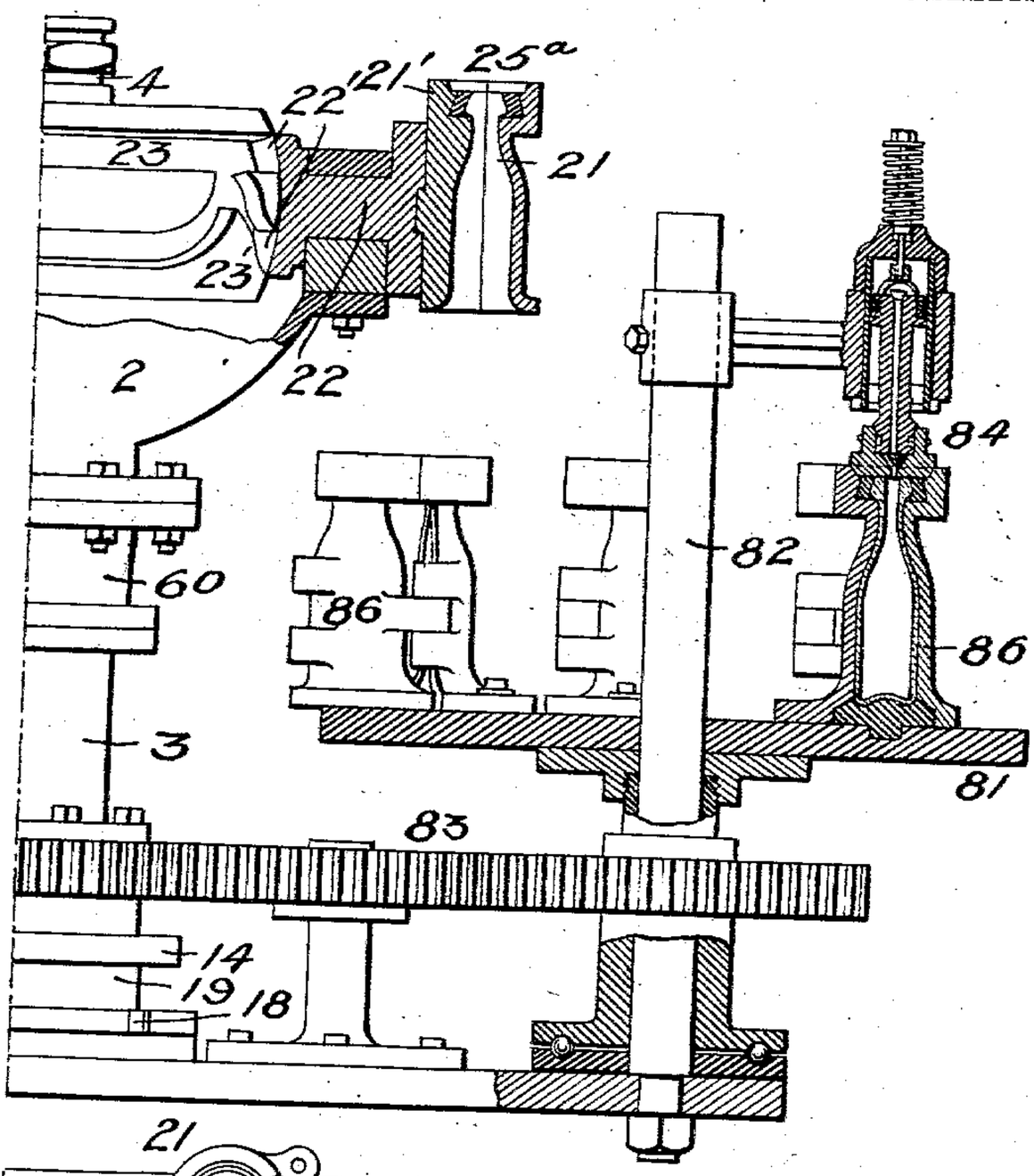
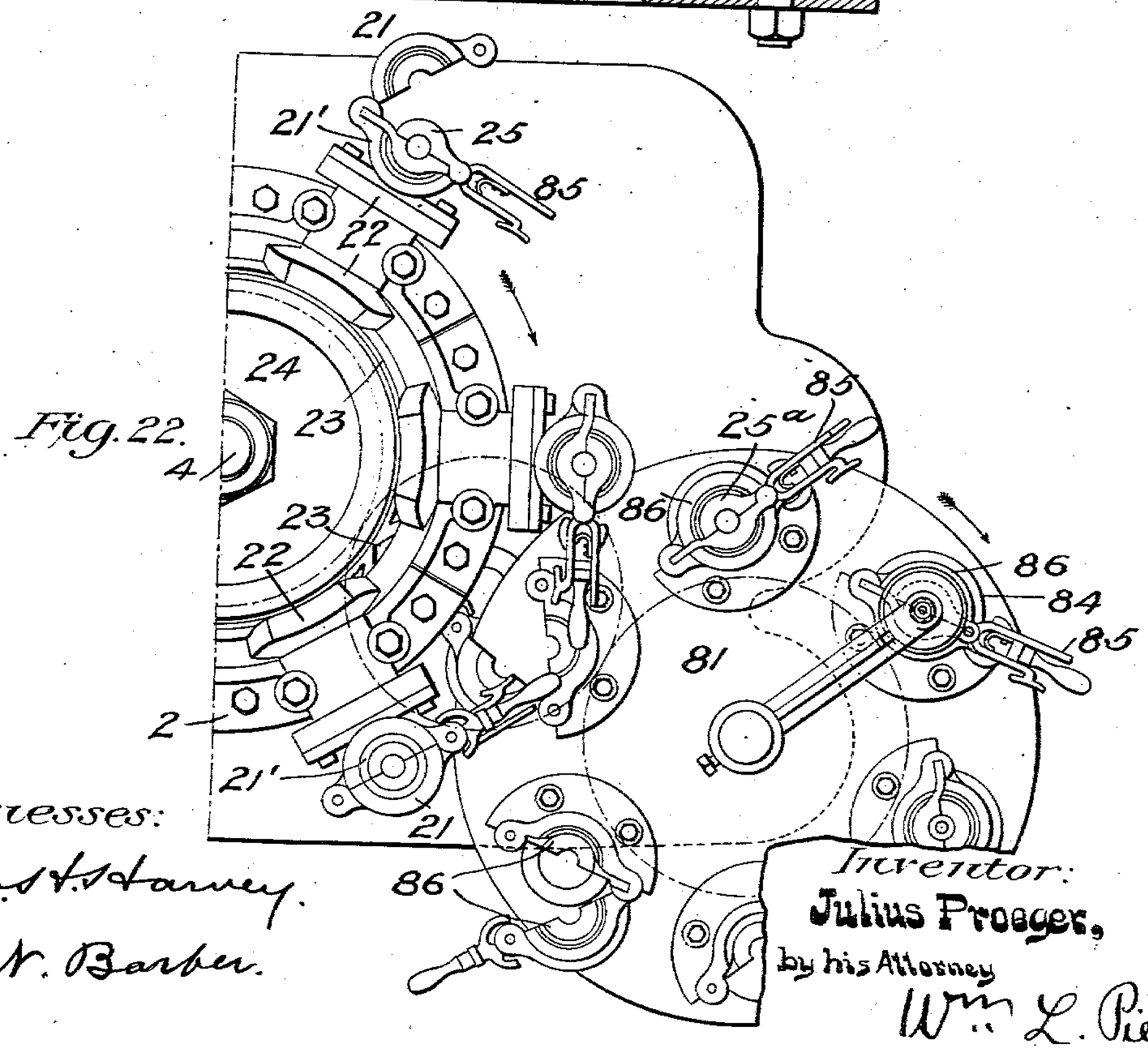


Fig. 22.



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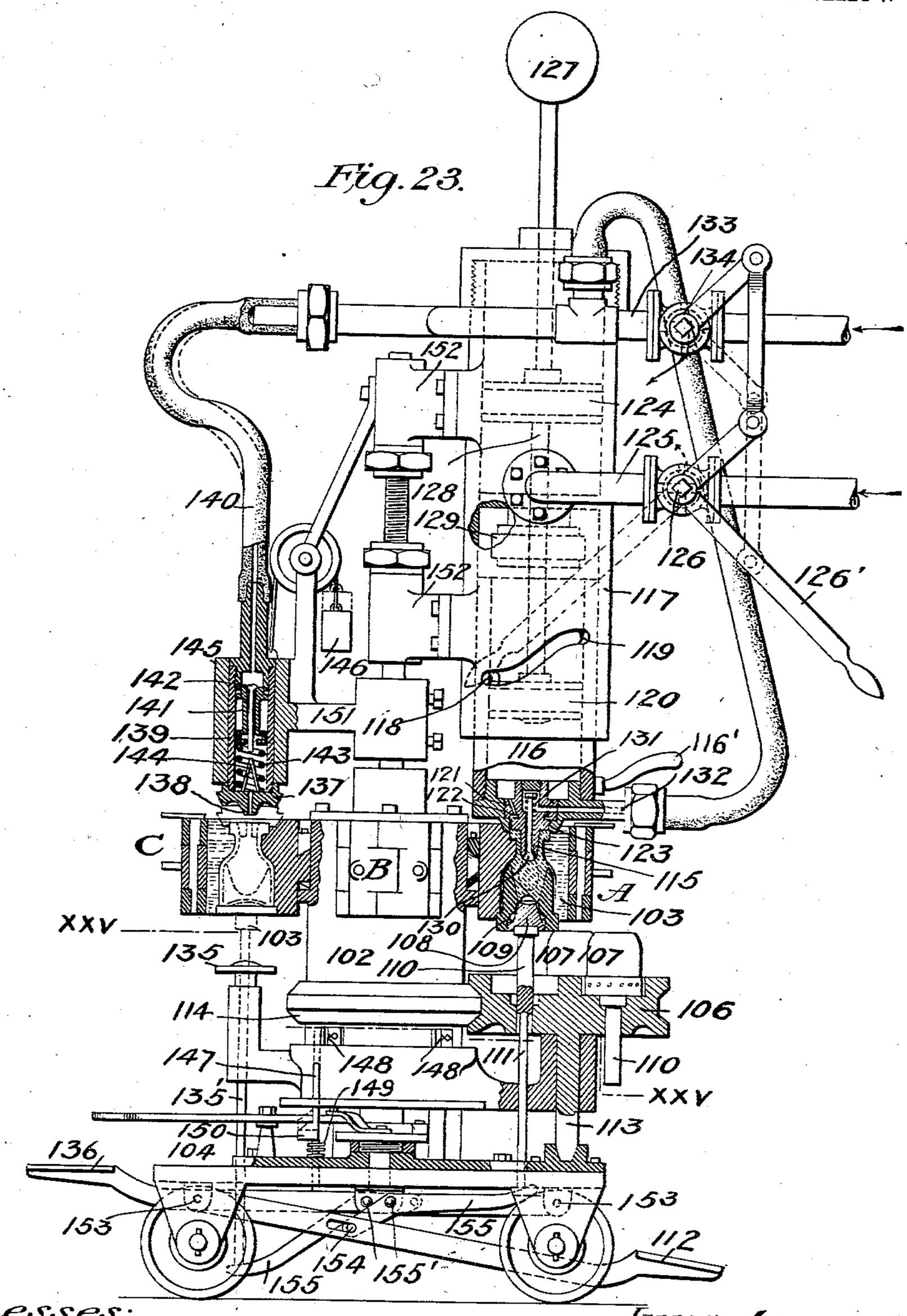
APPLICATION FILED APR. 1, 1902.

NO MODEL. 8 SHEETS—SHEET 7.

Fig. 23.



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APPLICATION FILED APR. 1, 1902.

NO MODEL. 8 SHEETS—SHEET 8.

Fig. 24.

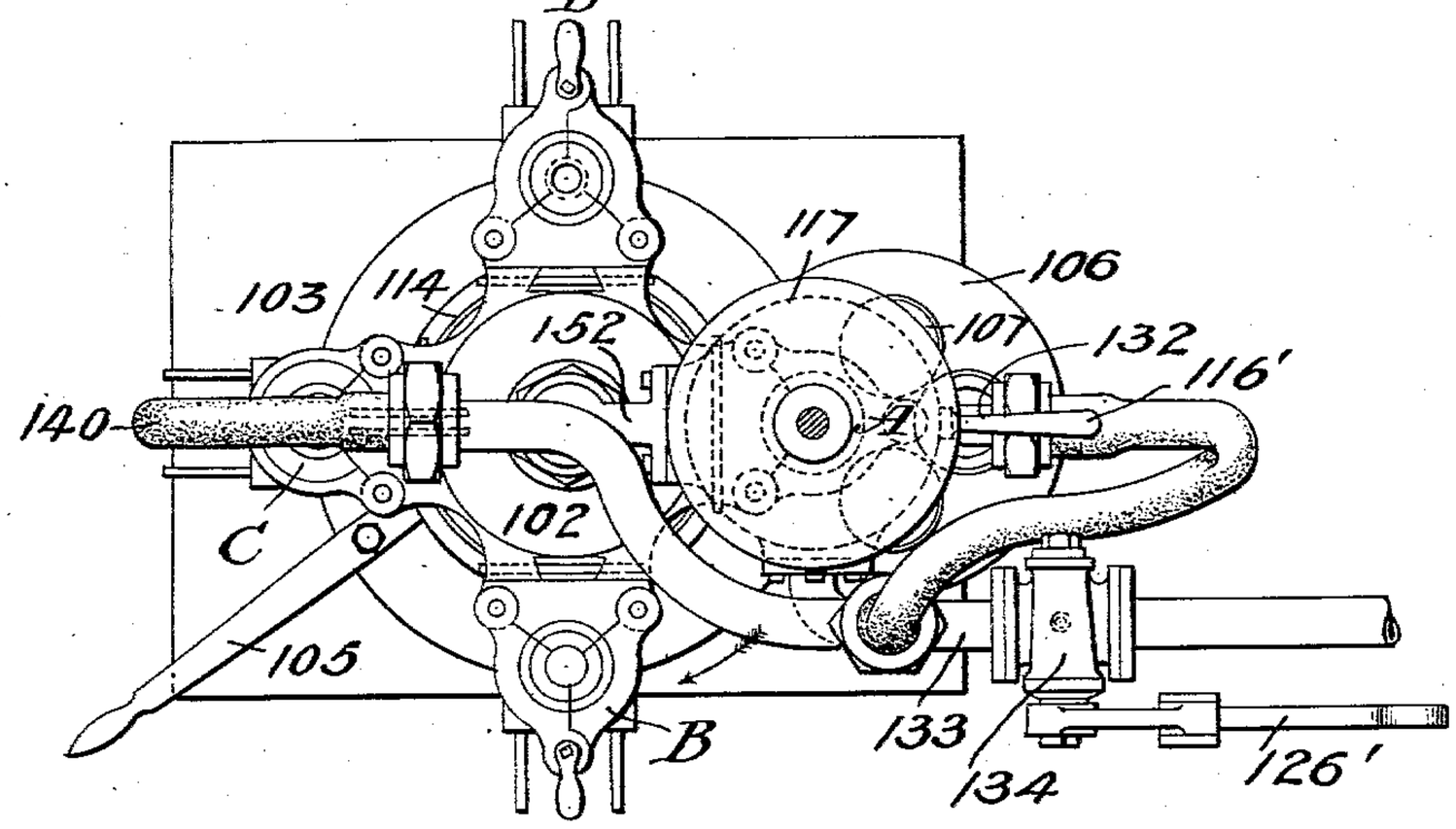


Fig. 25.

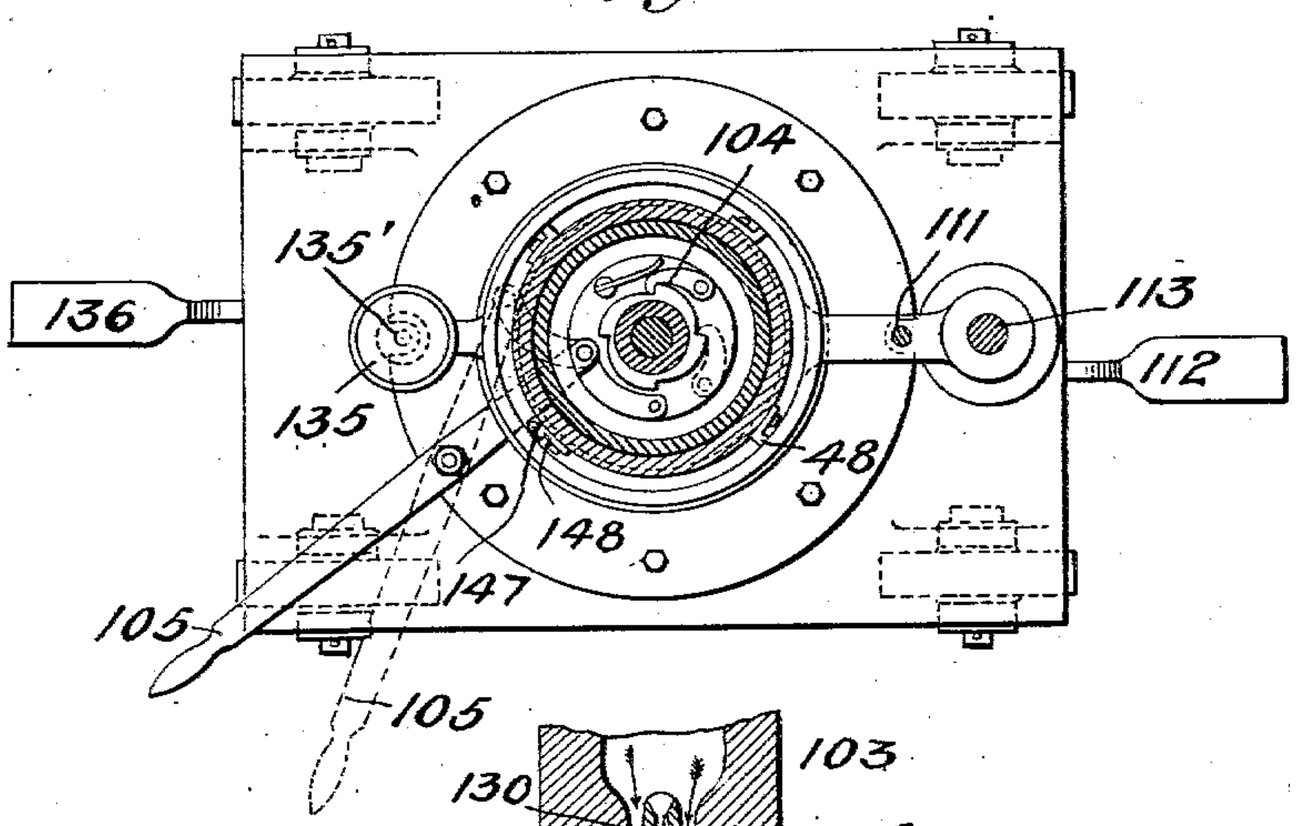
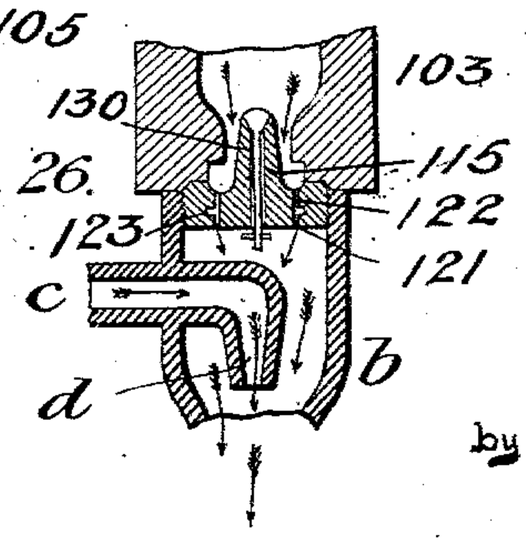


Fig. 26.



Witnesses.

Geo. H. Harvey.

F. N. Barber.

Inventor:

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by his Attorney

Wm. L. Pierce

No. 744,007. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

JULIUS PROEGER, OF GREENSBURG, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TOLEDO GLASS COMPANY, OF TOLEDO, OHIO, A CORPORATION OF OHIO.

MANUFACTURE OF GLASSWARE.

SPECIFICATION forming part of Letters Patent No. 744,007, dated November 10, 1903.

Original application filed May 22, 1900, Serial No. 17,527. Divided and this application filed April 1, 1902. Serial No. 101,175. (No specimens.)

To all whom it may concern:

Be it known that I, JULIUS PROEGER, a citizen of the United States, residing at Greensburg, in the county of Westmoreland and State of Pennsylvania, have invented or discovered new and useful Improvements in the Manufacture of Glassware, of which the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1 is a side elevation of my improved machine, partly in vertical section. Figs. 2, 3, 4, and 5 are detail views, Fig. 2 being a top plan view of one of the molds partly open. Fig. 3 is a horizontal section of the neck end of the mold looking upwardly. Fig. 4 is a detail view of a modified construction of bottom for the mold, and Fig. 5 is a vertical sectional view of the valve for controlling the traveling bottom shown in Fig. 1. Fig. 6, Sheet 2, is a top plan view of Fig. 1. Fig. 7 is a horizontal section on the line VII VII of Fig. 1, showing the roasting mechanism and the mechanism for moving the traveling bottom. Fig. 8, Sheet 3, is a longitudinal section on the line VIII VIII of Fig. 6, the suction device being in communication with the mold-cavity. Fig. 9 is a detail sectional view of the mouth of the suction device. Fig. 10 is a vertical sectional view of the foot of the rotary mold-carrying standard. Fig. 11, Sheet 4, is a front elevation of the machine, the parts being in the same position as shown in Fig. 1. Fig. 12 is a detail view of the upper portion of the mold-carrying standard, showing the cam-grooves for reversing the molds and the cam-grooves for tilting the cup. Fig. 13 is a plan view of Fig. 12. Fig. 14, Sheet 5, is a detail vertical section of a part of the apparatus, showing the mechanism for operating the traveling bottom, the mold, and a blow-head, the latter being supported differently from the devices of the preceding figures in that it is arranged to travel with the traveling bottom. Fig. 15 is a vertical section of an apparatus of modified construction, showing the parts as they are just after the sucking of the blank. Fig. 16 is a horizontal section on the line XVI XVI of Fig. 15. Fig. 17 is a vertical section of the mold of Fig. 15 in reversed position with the bottle blown to final form. Fig. 18 is a detail side elevation of the lever mechanism for operating the valve which controls the lowering of the cup in which the gathering of glass is placed. Fig. 19 is a horizontal section on the line XIX XIX of Fig. 15. Fig. 20 is a horizontal section of the valve which controls the movement of the bottom and which supplies the air for blowing the initial cavity in the blank of Fig. 15. Fig. 21, Sheet 6, is a side elevation, partly in vertical section, of apparatus like that of Fig. 1, modified in such manner that the blanks after being partially formed in the molds 21 are transferred to other molds 86, in which they are finished. Fig. 22 is a top plan view of the apparatus shown in Fig. 1. Fig. 23, Sheet 7, is a sectional side elevation of a modified machine. Fig. 24 is a plan view thereof, and Fig. 25 is a horizontal section on the line XXV XXV of Fig. 23, and Fig. 26 is a detail section of a suction device of modified construction.

This application is a division of my application Serial No. 17,527, filed May 22, 1900, the subject-matter of certain of the claims annexed hereto having formed a part of my application Serial No. 665,638, filed January 5, 1898.

The purpose of my invention is to provide a method of manufacture whereby articles of hollow glassware can be formed rapidly, cheaply, and of perfect form. By its use I am enabled to dispense with much labor heretofore necessary to be employed and reduce the cost of manufacture to a minimum. So far as narrow neckware is concerned this apparatus shows, so far as I am aware, the first practical machine for manufacturing the same in distinction from manual processes.

In the accompanying drawings I show the preferable form of apparatus in which my invention can be practiced; but it will be understood by those skilled in the art that the same may be modified in various ways without departure from the principles of my invention as defined in the broad claims of this specification. In fact, I myself have

already devised and in some instances built alternative apparatus for accomplishing several of the steps of the present process.

On Sheets 1 to 4 of the drawings I show a movable (preferably rotary) mold-carrier 2, mounted in a vertical standard 3, which is rotatory around a fixed post 4, forming part of the fixed frame structure 4′ of the machine. The standard may be stepped on ball-bearings 5 and provided with adjusting devices 6, by which it may be adjusted and the mold-carrier held level, so that the molds are kept in truly vertical positions.

To rotate the standard 3 in step-by-step fashion, I may employ a hand-lever 7, pivoted at 8 to the base of the machine and connected by suitable mechanism, preferably a link 9, slide 10, link 11, lever 12, (pivoted at 12′,) and link 13, to a loose ring 14, carrying a spring-pressed pawl 15, which engages ratchet-teeth 16 on the standard 3. The standard normally may be locked by a detent 17, adapted to engage in succession notches 18 on the standard or on a ring 19, fixed thereto, so that during the periods when the blank is being formed the mold-carrier may be held rigidly. The parts are preferably so arranged that the act of moving the hand-lever 7 into the position shown in Figs. 1 and 7 shall cause a cam-surface 20 to engage the detent 17 or a projection 17′ thereon and shall disengage the detent from the standard, so that when the lever is drawn back the standard and mold-carrier will be free to be revolved thereby. At each operation of the lever the standard and mold-carrier are turned through a partial revolution—in the construction illustrated through an arc of sixty degrees.

The mold-carrier 2 consists of a frame having several (in the drawings six) molds 21 journaled thereon on axes 22, which are opposite or nearly opposite to the middle of the length of the mold-cavity. Although not indispensable, this relative location of the axis to the center of the mold I consider highly important, as it greatly reduces the tendency of the blank to swing laterally in the mold during the mold's reversal and lessens the danger of the free portion of the blank becoming attached to the side walls of the mold, thus ruining the articles. At a certain period of travel of each mold it is preferably reversed in position, turned through one hundred and eighty degrees by suitable mechanism, which may comprise cam-guides, preferably grooves 23, Figs. 8 and 12, formed on a head 24 of the fixed post 4, and at a point 23′ the guides are shaped in the manner of an open switch, so as to deflect the projections or rollers 22′, which extend from the journals of the molds into the guides, and to cause each projection to exchange position with the other, the upper projection to enter the lower guide and the lower projection to enter the upper guide, thus reversing the mold.

The molds 21 are of suitable construction, preferably divided vertically into two parts and open at the ends. The interior in the construction shown in Figs. 1 to 14 is of the shape of the bottle to be formed therein, and at the neck end of the mold is a ring 25, which is held by the mold-sections, as explained hereinafter, and is of proper form to shape the neck end of the bottle.

In the operation of the mechanism shown in Figs. 1 to 14 a gathering of glass is dropped into the mold, the neck end of which is downward, a head is brought into contact with the neck end of the mold, a suction is created, so as to draw the glass into the neck portion of the matrix and to shape the neck of the bottle. Air is then preferably blown into the neck through the nose of the head, which projects into the glass, and in this manner a preliminary cavity is formed in the blank. The head is then lowered, the mold-carrier rotated to bring the mold to a second station, during which motion the mold is inverted. At the second station a bottom is applied to the mold, and the blank is freed from the sides of the mold while still supported by the neck-ring 25 and is allowed to elongate by gravity to the extent desired. The mold-carrier is rotated one step more. A blow-head is then applied to the mold, and the glass blank is expanded within the mold, preferably to its final form, or the glass may be blown up to finished form at any subsequent station to the sucking-station.

I will now describe the means which I have devised for performing these operations.

First. The cup for introducing the glass into the mold.—If desired, the gathering of glass may be dropped directly from the gathering-tool into the open end of the bottle-mold, which at the first station A is neck downward; but I prefer to employ a cup 26, in which the gathering is received and from which it is delivered into the mold.

The cup 26 has a shank 27 journaled on a bracket-arm 28, which extends radially from the post 4 and is adapted to swing horizontally around the same concentrically with the mold-carrier 2. To turn the shank 27, I employ cam grooves or guides 29, which are formed on a curved plate 30 on the head 24 and receive projections or rollers 27′ on the shank. As the bracket-arm is swung around the post 4 these projections are guided by a switch-like portion 29′ of the grooves, Fig. 12, and turn the shank and the cup through a half-revolution. The parts are so arranged that when the cup is thus inverted its mouth shall be directly over the mold 21 at the first station end A, (shown in Figs. 8 and 11,) and in order that the motion of the cup while it is being inverted shall be in the nature of a planetary motion or eccentric sweep I place the cup out of line from the axis of the shank. It is preferable to employ means by which the glass when introduced into the cup may be held at the base thereof until the cup has been completely inverted over the mold. For

this purpose I prefer to use suction, and a convenient way of effecting this is to form at the bottom of the cup a chamber 31, separated from the cup by a perforated movable bottom 32. The chamber 31 has an air-inlet 33, which directs the air therefrom through an air-outlet 34 in the opposite side of the chamber 31, and the construction is such that when the cup is moved to its inverted position over the mold at the station A the outlet will be closed, preferably by coming into contact with a spring-backed plate or stop 35, Figs. 1 and 11. When the cup is in its upright position, (shown in Fig. 12,) the gathering of glass is placed in it and the air blown through the pipe 33, and therefore through the chamber 31, produces a partial vacuum in the chamber 31, which holds the glass upon the bottom of the cup. Then by a handle 36 or other convenient means the operator swings the bracket-arm 28 horizontally, thus bringing the cup directly over the mold at the station A and inverting it. The closing of the air-outlet of the chamber 31 by the plate 35 stops the sucking action and creates an internal air-pressure which moves the bottom 32 of the cup inwardly toward the cup-cavity and discharges the gathering of glass into the mold 21 directly beneath the same. The cup is not only a convenient means for delivering the glass to the molds, but it also serves another important function in that it chills somewhat the gathering of glass at the end which is to form the bottom of the bottle, and thus gives to the outer skin or surface of the glass at that point sufficient strength to hold the glass together and prevent it from flowing too freely or being perforated by the blast of air which is afterward blown into it.

Within the scope of my invention, as broadly claimed, other means for surface-chilling the bottom portion of the bottle-blank may be employed, as will appear in the description of some of the modifications of my apparatus. The cup is also of use in that it gives a preliminary shaping to the gathering of the glass and delivers it to the mold in the form and condition best suited for the subsequent operation.

Second. The head by which the glass is sucked and blown.—Beneath the first station A is the head 37, provided with suitable means for bringing it into communication with the neck end of the mold. For the latter purpose I prefer the following mechanism: Between suitable posts or standards constituting part of the framework 4′ is a guide 38, carrying a vertically-movable cylinder 39, at the upper end of which is the head 37. (Shown in detail in Fig. 9.) The head has a central nose 40 adapted to fit within the ring 25 and to enter the mouth of the glass blank, which is formed around it. This nose is preferably provided with an inwardly-seating valve 41, backed by a spring 42 and adapted to be unseated by pressure of air introduced through a pipe 43, which may be connected with a holder of compressed air, but which I prefer to connect with a small hand-pump 44, adapted to deliver a known volume of air at each stroke of a handle 45. Around the nose 40 is an annular suction-port 46, which when the head is in contact with the mold communicates with the interior of the cylinder 39 by the passage 46′ 46′ and with the mouth of the rings 25. The cylinder 39 is carried by a bracket 47, secured to a second cylinder 48, the lower head of which is secured to the hollow piston-rod 49 of a piston 49′ within a third cylinder 50. The cylinders 39, 48, and 50 are arranged in line, and a central post 51 extends through the cylinder 50 and through the piston-rod 49 to the end of the cylinder 48 when the latter is at its lowest position. A stem 52 connects the pistons 39′ and 48′ and passes through a stuffing-box at the head of the cylinder 48. In order to bring the head 37 to the mold 21, fluid (preferably compressed air) is admitted into the cylinder 50 by operation of a valve 53, moved by handle 53′, the effect of which is to raise the piston 49, with the cylinders 46 and 39, and to bring the parts into the position shown in dotted lines in Fig. 8. The valve 53 is suitably connected with the port of the cylinder 50 by a pipe 54, as shown in Figs. 1, 8, and 11.

Third. The sucking of the glass into the neck of the mold.—The glass having been introduced into the mold and the head 37 having been brought to the mold, as above explained, the next operation is to cause a suction which will draw the glass down into the neck-cavity, and thus form the neck of the bottle. This suction, which is preferably produced as soon as possible after the introduction of the glass into the mold or simultaneously therewith, takes place through suction-passages 46′, which are preferably very narrow, so that they will permit the passage of air, but will exclude the glass. Various means may be employed for creating a suction, but I prefer to accomplish it by backward motion of the piston 39′. A valve 55 controls the admission of compressed air into the cylinder 48 and is preferably adapted to be unseated by contact of a stem 56 with a stop 57 when the cylinders are moved to bring the head to the mold 21. When the valve is thus unseated, the air passing into the cylinder 48 moves back its piston and through the rod 52 retracts the piston 39′, creating in the cylinder 39 a partial vacuum, which acts through the passages 46′ and the port 46 and sucks the glass down into the ring 25 and around the nose 40, thus shaping the head of the bottle.

Fourth. The blowing of the preliminary cavity in the blank.—The next operation is preferably the forming of a preliminary cavity in the blank. To do this, while the mold is at the station A, as shown in Fig. 8, the operator gives a stroke to the lever 45, thus operating the pump 44 and delivering through the nose 40 a jet of air of measured volume which unseats the valve 41 and blows a cavity in the

blank, substantially as shown by dotted lines in Fig. 8, although the same may be larger or smaller. This completes the operations at station A. The head is then removed from the mold by operating the valve 53, so as to exhaust the air from the cylinder 50, whereupon the piston 49, with the cylinders 48 and 39, will recede from the mold, the cylinder 48 being connected with its exhaust-port 58 by the retraction of the stem 56 and the stop 57. When the cylinders 48 and 39 recede, their pistons are supported by the stem 51 and are thus brought to the ends of the cylinders. The cup 26 being then or having been previously drawn back from the mold 21 into its initial position the mold is ready to be brought to the second station B. This I effect by moving the lever 7 so as to turn the standard and mold-carrier, and in moving to station B the mold is inverted by the cam guides or grooves 23, as already explained.

Fifth. The operation of the mold-bottom.—The traveling bottom 59, Figs. 1, 7, and 11, is of suitable shape to fit the bottom of the mold and is carried by a bracket 60, journaled on the standard 3, so that it may swing radially thereon and may carry the bottom back and forth between the third or blowing station C and the second station B. The bottom is vertically movable, preferably by a piston 61', Fig. 14, to which it is connected and which works in a cylinder 61. This cylinder is operated by an air-pipe 62, controlled by a valve 62', which for convenience is preferably placed on the handle of the lever 7. When the valve is operated to admit air to the cylinder 61, the movable bottom is drawn thereby away from the mold, and its reverse motion toward the mold may be accomplished by a spring 63, which acts when the air-supply is cut off from the piston 61. As a convenient means for swinging the bracket 60, so as to carry the mold-bottom between the stations B and C, I may employ a forked lever 64, pivoted to a bracket 65 on the frame of the machine and connected by a link 66 and arm 66' with the slide 10, which, as above explained, is moved by the lever 7. The consequence is that when the lever 7 is moved to the left for the purpose of moving the pawl 15 to get a new bite on the ratchet 16 the bracket 60, with the traveling bottom, is swung from station C to station B. Beneath the mold at the station B the valve 62' is operated so as to permit the spring 63 to raise the bottom to the mold, and when the operator draws back the lever 7, so as to turn the mold-carrier and to bring the mold from station B to station C, the bracket 60 and the movable bottom will travel with the mold to station C, being actuated by the lever 7 through the slide 10 and lever 64.

Sixth. The freeing and elongation of the body of the blank.—Shortly after the mold has been inverted and has come to station B the sides of the blank are freed from contact with the mold and the blank is allowed to elongate by gravity, so as to approach the vertical dimension of the finished bottle. I effect this preferably at or immediately after the bottom 59 has been applied to the mold by opening the mold-sections, leaving the blank suspended within the neck-ring. The mold-sections are opened by moving the sections slightly on their hinge; but it is desirable that when this is done the neck-ring by which the blank is supported shall be maintained in substantially central position between the mold-sections in order that the glass shall not come in contact with the walls of the mold on either side. For this purpose I prefer to use the mechanism shown in Figs. 2 and 3. The neck-ring of the mold is divided in sections 25 25' on the same plane as the sections of the body portions of the mold. The ring-section 25 is joined to one of the mold-sections 21' by a loose connection consisting, preferably, of a stud 67 on the neck-ring which extends through a hole in the mold-section and permits independent motion of the neck-ring to the extent of the distance between the head of the stud and the side of the mold-section. The other ring-section 25' has a like loose connection 68 with the mold-section 21, permitting a slight independent motion of the latter. The ring-sections 25 and 25' are supported in a countersunk seat at the end of the mold-sections and are provided with a friction-catch, which may consist of a rod 69 on the one bearing against an arm 69' on the other and which serves to hold the ring-sections together frictionally and to oppose a slight resistance to their separation. In order to free the glass blank from the sides of the mold, the workman seizes the handle 70, disengages thereby the catch 70', by which the mold-sections are held together, and moves the mold-section on its hinge 71. The section 21 moves outward freely from the ring-section 25' until the end of the loose connection 68 is reached, whereupon it will draw the ring-sections 25 25' with it until the end of the loose connection 67 is reached, at which time the workman ceases to open the mold. The ring is then midway between the partly-opened mold-sections, and the glass blank suspended from the ring hangs vertically centered in the middle of the mold-cavity without touching either side. (See Figs. 2 to 14.) During these operations the friction-catch 69 69' prevents the separation of the ring-sections 25 25'. While the mold is held thus partly open, the glass blank elongates under the influence of gravity, and when it reaches the desired length, preferably when the bottom of the blank reaches or nearly reaches the bottom 59, the mold-sections are again closed around the blank. Meanwhile the mold-carrier is turned, as above described, so as to carry the mold to the third station C, and in this motion it is accompanied by the traveling bottom 59, which remains in place at the end of the mold.

Obviously the friction-catch above de-

scribed does not interfere with the complete opening of the neck-sections when it is desirable to remove the finished bottle.

Seventh. The blowing of the blank to final form.—In line with the cavity of the mold at the third station C is a blow-head, which in Figs. 1 to 13 is shown as mounted stationary on a bracket 72, projecting from the frame 4'. This blow-head 73 is arranged to be moved into contact with the mold, preferably by being connected to a piston 74, movable in a cylinder 75, and has extending through it an air-passage, which is closed by a valve 76, the stem of which is carried in said air-passage. The blow-head has a slight longitudinal movement on the piston 74, and when it is brought into contact with the mold the stem of the valve by engagement with the blow-head will be stopped. Further movement of the piston brings the valve-seat of the valve below the valve proper so as to admit compressed air from the cylinder 75 to the blow-head, and thence into the interior of the glass blank. The compressed air is supplied from the pipe 77, controlled by the valve 53. When the mold is brought to station C, the operator manipulates the valve so as to admit air to the cylinder 75. Thereupon the piston 74 is depressed, the blow-head is brought to its seat on the end of the mold, the valve 76 is unseated, and the compressed air passes into the mold and expands the glass blank into the form of the finished bottle. The air may then be cut off from the cylinder 75, and the latter connected with the exhaust, whereupon the blow-head will be drawn back by a retracting-spring 78.

Removing finished ware.—The mold-carrier is then moved one step to carry the mold to the fourth station, and at this station or on the way thereto the mold may be completely opened, as shown at D in Fig. 6, and the glass bottle removed and taken to the annealing-oven without any further shaping and manipulation of the neck, such as has been required heretofore in making bottles, for the neck will have been or may have been completed by the sucking of the glass into the mold at station A. As the mold-carrier proceeds the mold under consideration is again inverted and brought into the position shown at E in Fig. 6, its neck end then being downward, and in this position it travels until it reaches again the station A.

I have explained above the operation of the apparatus in making a single bottle, describing the steps which are performed at each of the several stations, but it will be understood that throughout the working of the machine these steps are being carried on at once in two or more molds at the stations A, B, and C—that is to say, while one mold is being charged with glass at the station A a second mold is at the station B and a third mold is at the station C, where the blank is expanded into final form. In some cases, however, where not much stretching is required the blank may be blown up at station B. It will be understood, however, that while this multiple operation of the machine is claimed by me specifically the broader claims of this specification are not limited thereto. One of the most important savings of the machine is the complete formation of the neck by sucking without the costly reheating and hand-finishing of the same.

The modified traveling blow-head of Fig. 14.—In Fig. 14 I show a modification of my invention, in which the blow-head 73ª travels with the movable bottom instead of being mounted in a stationary bracket, as above described. For this purpose a bracket 79 is extended from the brackets 60 of the movable bottom, and the cylinder 75ª of the blow-head is mounted thereon. Otherwise the operation and construction are as above described, but the blow-head may be brought down upon the mold either at the station B or at any time between the stations B and C, and the air may be admitted to expand the blank when desired. As the bottom and the blow-head are never at station A the construction shown by this figure may be used instead of the bottom and head shown in Fig. 1.

The modified mold-bottom of Fig. 4.—In Fig. 4 I show a mold-bottom 59ª, which does not travel with the mold, but is operated by a stationary cylinder 80. Such cylinder is fixed under the blow-head at the station C, or the blow-head may be set over the mold-carrier at the station B, in which case the stationary bottom should also be located at station B. Such stationary or non-traveling bottom may be employed in the manufacture of some articles of glassware; but in some cases the traveling bottom is necessary, and I believe it to be always preferable.

The supplemental blowing-molds of Figs. 21 and 22.—In blowing some kinds of glassware, especially long bottles, it is desirable to blow the blank nearly to finished form in one mold and then to expand it finally in a second matrix or mold, either by removing the blank from one mold to another or otherwise surrounding it by a second matrix after its initial shaping. In Figs. 21 and 22 I show convenient means by which it may be done. At or near the station C, I employ a second mold-carrier 81, arranged to be rotated around a post 82 by suitable gearing 83, connected with the rotating standard 3. On the post 82 is a second blow-head 84, which may be constructed and arranged similarly to the blow-head 73 above described. The molds 21 may be constructed as already described, except that the body portion of the matrix-cavity has not the form of the finished bottle, but is of the shape of the blank to be produced, and the neck-ring 25ª has a handle 85, adapting it to be lifted from the mold. With this form of my invention after the blank has been blown at station C, as above described, the mold is opened, the neck-ring is lifted so as to take the blank out of the mold 21, the

article is then transferred to a mold 86 on the carrier 81, and by the rotation of the latter carrier it is brought under the blow-head 84 and is there blown into its final form, after which it may be removed and annealed. This construction gives greater output than if both blow-heads were arranged with the same mold-carrier, although this plan is feasible.

The modified construction of Figs. 15 to 20.—In the modified construction shown in Figs. 15 to 20 there is a matrix in which the body of the blank is initially formed, the matrix being afterward removed from the blank, and another matrix in which the blank is blown to final shape is substituted therefor.

In Fig. 15 I show the mold 21 at the station A, at which position it is neck downward and is mounted on its carrier in the same manner as described with reference to Figs. 1 to 14, being in engagement with a head 37, which also may be constructed as above described. The other end of the mold contains a matrix or telescoping sleeve body blank mold 87, the interior of which is of the initial shape desired for the body of the blank and which is arranged to be movable into and removable from the mold at the station A. For this purpose I may employ cylinders 88, whose pistons 88′ are connected with the matrix-section 87 and are adapted to move the same into the mold 21, their removal being effected by a counterbalancing weight or spring 89, connected with the pistons by a lever 90. The valve 91 of the cylinders 88 may be operated independently, but it is preferably operated by the motion of the lever 7, so that when the lever 7 is moved to bring the mold to the station A the cylinders 88 will immediately move the section 87 into the mold-cavity. For this purpose I may arrange the valve-lever 92, Fig. 18, so that it will be engaged by a projection 93 on the link 9, which is connected with and moved by the hand-lever 7. When the cup 32 is not used, the gathering of glass is dropped from the gathering-tool directly into the mold, and in order to accomplish the chilling of the bottom of the gathering, which in the construction of Fig. 1 is performed by the cup, I may employ a movable end piece 94, adapted to be moved by suitable means, preferably a cylinder 95 and piston 95′, into the end of the matrix-section 87. The valve 96, by which the cylinder 95 is controlled, is shown in detail in Fig. 20 and preferably has ports 95^a and 43^a, which lead, respectively, to the cylinder 95 and to the nose 40 of the head 37, the valve being so arranged that it will successively cause the approach of the bottom 94 to the mold and the admission of air to the nose 40. The operation is as follows: The lever 7 having been moved to bring the mold 21 to station A, the valve 91 is operated as above explained, so as to introduce the matrix-section 87 into the mold 21. The gathering of glass is then dropped into the mold, and by suction, as above explained with reference to Figs. 1 to 14, the glass is drawn into the neck portion of the mold-cavity. The valve 96 is then moved so as successively to close the cavity of the matrix-section 87 by bringing the bottom piece 94 thereto and then to admit air to the nose 40. The air passes into the glass blank and forms an initial cavity therein, expanding it within the matrix-section 87 and chilling slightly the surface of the glass by bringing it into contact with the end piece 94. The valve 96 is then reversed to exhaust position, and the lever 7 is pushed back to get a new grasp on the ratchet of the standard 3. This causes a reversal of the valve 91, turning it also to exhaust position, and thereupon the counterweight 89 raises the pistons 88′ and by engagement of a cross-head 97 on said pistons with a stop 98 on the piston 95′ the matrix-section 87 and the movable end piece 94 are moved together out of the mold. The head 37 is retracted, as above described, and the operator then moves back the lever 7, so as to advance the mold-carrier to invert the mold and to bring it to a succeeding station, which is illustrated in Fig. 17. The mold is then bottom side down, with the blank hanging suspended therein from the neck. A finishing mold-section 99, whose matrix is of the shape of the body of the finished bottle, is then raised by suitable means, preferably a cylinder 100 and piston 100′, so as to inclose the lower portion of the blank, a blow-head 73 is brought down upon the mold, and air is blown therethrough, expanding the blank within the section 99 and forming the finished article. If desired, the finishing mold-section 99 by obvious modifications may be inserted without the mold-carrier. Preferably the blank will be allowed to elongate by gravity after being reversed, so as to touch the bottom of section 99 before the blank is blown to finished form. After the blowing of the blank the mold-section 99 and the blow-head may be retracted, the mold-carrier advanced, and the glass bottle removed. The mold-section 99 is preferably made of a single piece, not sectional, and when so constructed should be provided with an air-vent 101.

The modified apparatus of Figs. 23 to 26.—In the apparatus of Figs. 23 to 26 although many of the essential features of the apparatus and method above described are employed the apparatus is modified in various ways. For example, the cup in which the gathering of glass is placed is not tipped to discharge the glass, nor are the molds inverted during the formation of the article. To move the molds 103, I employ a rotary standard 102, mounted upon a central shaft or step and carrying the molds, which are arranged around its periphery, as shown at A B C D in Fig. 24. This standard is driven by a pawl-and-ratchet mechanism 104, (illustrated in Fig. 25,) operated by a hand-lever 105 or otherwise, so that at each operation of the ratchet the standard will be turned

one step, in the construction illustrated one-fourth of a revolution, there being four molds on the sleeve.

Beneath the station A, in which the neck of the blank is formed by suction, is a movable (preferably a rotary) table 106, carrying a series of cups 107, adapted to receive the gathering of glass. One of the cups is shown in section in Fig. 23. It has a matrix-cavity in which the glass is received, and a base composed of a plug 108, fixed to the body of the cup and formed with an air-passage or air-passages 109 of small size adapted to admit air to the interior of the matrix when suction takes place. The plug and the body of the cup may be made in a single piece. The cups have stems 110, by which they may be raised vertically into the mold-cavity when they are successfully brought thereunder by rotation of the table, and to lift the stem I use a pusher-rod 111, adapted to be raised by a foot-lever 112. The table 106 is mounted on a vertical shaft or stem 113 and is rotated simultaneously with the rotation of the standard 102, preferably by engagement of a friction-wheel 114 on said standard with the periphery wheel of the table.

The molds 103 are open at the bottom to permit insertion of one of the cups, and the upper part of the mold-matrix has the shape desired to be given to the end of the blank formed therein. Above the mold at the station A is a blowing apparatus comprising a hallow stem 115, carried by a vertically-moving head 116, which is movable downwardly, so as to bring the stem 115 into the matrix of the mold. As a convenient means of effecting this motion I may mount the head 116 in a cylindrical casing 117 and fit a pin 118 on the plunger on an inclined groove 119 in the casing, so that when the head is turned by a handle 116′ it will also be caused to move vertically. To produce the exhaustion of air by which the suction is caused, I make the head 116 tubular, so that it may serve as a cylinder with respect to an internal piston 120, the raising of which will cause a rarefaction of air in the head 116 below it. Air-passages 121 of small diameter lead from the cavity in the head 116 into the chamber 122, whence air-passages 123 of small diameter lead through the head of the stem 115 and terminate at the part thereof which when the stem is inserted in the molds is at the end of the matrix-cavity. The piston 120 may be operated by a motor-piston 124, contained within the casing 117 above the hollow head 116 and operated by compressed air admitted from a pipe 125 and controlled by a valve 126, which when its lever 126′ is in the position shown in Fig. 23 by full lines will admit air to raise the piston and to cause a suction in the lower part of the head 116 and which when turned into the position shown in dotted lines causes the air to exhaust and permits the piston 124 to be forced down by the action of a weight 127 or other retracting device. The piston 124 is connected with a suction-piston 120 by an intermediate stem passing through a stuffing-box 129, contained in the casing 117.

To admit air for the blowing and expanding of the blank, the stem 115 is made hollow, and the passage through it is closed by a valve 130, which is normally held in sealed position by a spring 131 and which may be unseated by the pressure of air flowing through the stem. The air is admitted through a pipe 132, leading from an air-supply pipe 133, whose valve 134 may be connected with the lever 126′ of the valve 126, so as to be opened to admit air to the pipe 132 by the same motion which connects the pipe 125 with the exhaust-port.

The operation of the parts of the apparatus which I have just described is as follows: The operator introduces into one of the cups 107 sufficient glass to fill the cup. The standard 102 is rotated by the mechanism 103, and the same motion which brings the mold around to the station A also turns the table 106, so as to bring a charged cup 107 into position directly below the matrix of the mold. The operator then by depressing the foot-lever 112 raises the cup, with its charge of glass, into the matrix of the mold and by the lever 116′ brings the plunger 116 downwardly, so as to cause the stem 115 to enter and to close the end of the matrix. Then by operation of the valve 126 the piston 124 is raised, moving also the piston 120 in the casing 117 and producing an exhaustion of air, which, connecting with the interior of the matrix through the air-ports 121, 122, and 123, sucks up the molten glass around the stem 115 and into the end of the matrix and forms the neck of a bottle of the shape desired. The valve-lever 126′ is then reversed, and the air is admitted thereby through the pipe 132, which, unseating the valve 130 and passing through the hollow stem 115, blows a cavity in the body of the blank, as shown by dotted lines in Fig. 23, thereby filling the cavity of the cup left by the glass, which has been displaced upwardly by the suction, although this preliminary blowing in some instances may be omitted. The cup is then withdrawn downwardly from the bottom of the mold, the blowing-stem is lifted from the neck of the mold, and the sleeve-standard 102 is turned a quarter-revolution to the station B, bringing another mold into position below the stem 115 and another cup 107, charged with glass, below the mold, whereupon the operation above described is repeated. The next quarter-turn of the standard brings the mold from the station B into the station C, at which the blank is finally expanded by blowing. For this purpose I provide at the station C a movable mold-bottom 135, which can be raised into contact with the mold by a foot-lever 136, engaging a stem 135′ of the mold-bottom.

The blowing apparatus comprises a vertically-movable cap 137, which fits on top of

the mold and has a nose 138, and above the cup and fixed thereto is a cylinder 139, connected with a curved flexible air-supply pipe 140, leading from the pipe 133. Within the cylinder 139 is a hollow piston 141, whose passage is closed by a valve 142. The piston is normally kept in elevated position by a spring 143; but when air is admitted through the pipe 140 the piston is moved downwardly until the end of the valve-stem engages a stop or projection 144, which will unseat the valve and permit the air to flow through the nose 138.

When the mold is brought into the station C and the valve 134 is opened by the same operation which admits air through the pipe 132, as above described, the air also enters the pipe 140, and as this pipe is flexible the passage of the air therethrough will force the cylinder 139 downwardly in its casing or guide 145 until the end of the cap 137 is seated upon the top of the mold. Further exertion of the air-pressure from the pipe 140 within the cylinder 139 will force down the piston 141 against the pressure of the spring 143, (said spring being made strong enough to uphold the piston until the cap 137 has been seated,) and at the end of the piston's motion when the valve-stem engages the stop 144 the valve is opened and the air passes through the nose into the matrix and expands the blank into its finished form, the mold-bottom 135 having been raised, so as to close the matrix before the blowing begins.

When the air is shut off by the valve 134, the piston 139 and cap 137 will be retracted by a weight 146. The mold-bottom then being dropped, the mold is brought at the next quarter-rotation of the standard 102 to the station D, at which it is opened and the finished article removed therefrom.

It will be understood that the operations of the machine are continuous, and at each quarter-revolution of the standard one of the cups 107, with glass charged therein, is brought to station A, an empty mold is also brought to station A, where the blank is initially formed, another mold, with a blank, is brought into the station B, where it is at rest, and a third mold into the station C, where the blank is finally expanded, and a fourth mold into the station D, where the finished article is removed, and that at each operation of the air-valve 134 a blank is initially sucked and blown at A, and another blank is finally blown at C. The station B is an idle station, and although it is preferable it is not essential to the operation of the machine.

Instead of constituting the larger matrix at A merely by removing a cup from the interior of the mold the same end may be otherwise attained by means now recognized as equivalents.

The following are some of the details of construction of the apparatus shown in the drawings and not already described:

In order that the molds may be locked or held positively in the several positions into which they are successively brought, I provide a latch-rod 147, adapted to engage stops 148 on the standards 102 and normally held in such engagement by a spring 149. When the lever is moved to turn the standard it engages a cam 150 on the latch and disengages it from the stop, so as to permit the standard to be rotated.

As shown in Fig. 23, the lugs or brackets 151 and 152, by which the casings 139 and 117 are respectively held, are preferably made vertically adjustable in order to provide for the proper adjustment of the parts of the machine.

I prefer that the levers 112 and 136 should be compound levers, each lever being pivoted at its end on a pivot 153 and at a middle point joined by a slotted connection 154 to the end of a lever 155, which is pivoted at 155′, and at its outer end bears upon the stem 111 or 135′, as the case may be. This construction of the levers makes it easy for the parts 111 and 135′, which are upheld thereby, to drop as soon as the foot-pressure is released.

In Fig. 26 I show instead of the piston for creating a suction by which the blank is formed an exhaust-pump *b*, operated by a steam or air jet from a pipe *c*, the ejector-pipe *d* producing a partial vacuum in the chamber connecting with the air-passages 121 122 123. Other mechanism for exhausting the air may be admitted.

The advantages of my invention consist in the cheapness and rapidity with which it enables me to make articles of glassware—such as jars, bottles, &c.—and in the excellent quality of the articles which are produced thereby. The invention is well adapted to the manufacture of narrow-neck bottles, which heretofore, so far as I know, had not been made successfully by machine. It will be understood, however, that although I have shown the apparatus adapted to carry out my method of manufacturing narrow-neck bottles my method is not limited thereto, but may be used for making glass articles of other kinds by suitable changes in the form and relation of the parts of the apparatus. As there are many novel and original features of process in my application independent of the novelty of sucking the neck, I desire to claim such features, both singly and in combination, even when some other method of forming the neck is resorted to. It will be understood also that parts of my invention stated in the individual claims may be used independently of the other parts or in other combinations and that changes may be made in the apparatus while still using my method, since

What I claim is—

1. The method of forming glass articles which consists in forming a blank pneumatically with a finished neck in inverted position, blowing upward through the neck of

the blank so formed to form a cavity in the blank, and then inverting the blank and expanding it.

2. The method of forming glass which consists in sucking plastic glass into the form of a blank, and then expanding the blank.

3. The method of forming glass which consists in sucking plastic glass into a matrix and then expanding by blowing the blank so formed.

4. The method of forming glass which consists in sucking glass into a matrix, and then blowing an incipient cavity therein, and then completely blowing and expanding the glass.

5. The method of forming hollow glass articles which consists in forming one end thereof by sucking, reversing the blank, elongating the blank and finally blowing to finished form.

6. The method of forming hollow glass articles which consists in forming one end thereof by sucking, blowing a preliminary air-cavity in the blank, reversing the blank, elongating the blank and finally blowing to finished form.

7. The method of forming glass articles in molds, which consists in forming one end thereof by sucking, reversing the mold, slightly opening the mold and permitting the blank to elongate by gravity, closing the mold and blowing to finished form.

8. The method of forming glass articles in molds which consists in forming one end thereof by sucking the glass in an open-ended mold, reversing the mold, applying a bottom to the open end and blowing to finished form.

9. The method of forming glass articles which consists in sucking one end complete with an attached blank mass of glass and blowing the blank to finished shape.

10. The method of forming glass articles which consists in sucking one end complete with an attached blank mass of glass formed in a removable matrix, stripping the blank of said matrix, inserting a new matrix and blowing to finished shape.

11. The method of forming a glassware blank which consists in sucking the glass into a tubular end with an attached mass of glass, then blowing through said tubular end and expanding said mass.

12. The method of forming glass articles which consists in sucking the glass into a tubular end with an attached mass of glass, blowing through said tubular end to expand the blank and finally blowing to finishing shape.

Signed at Columbus, Ohio, this 21st day of February, 1902.

JULIUS PROEGER.

Witnesses:
BENSON R. HEDGES,
GEORGE BEATTY.