No. 672,716. Patented Apr. 23, 1901.

H. SEMPLE.

MACHINE FOR BLOWING GLASSWARE.

(Application filed Sept. 25, 1900.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 10.

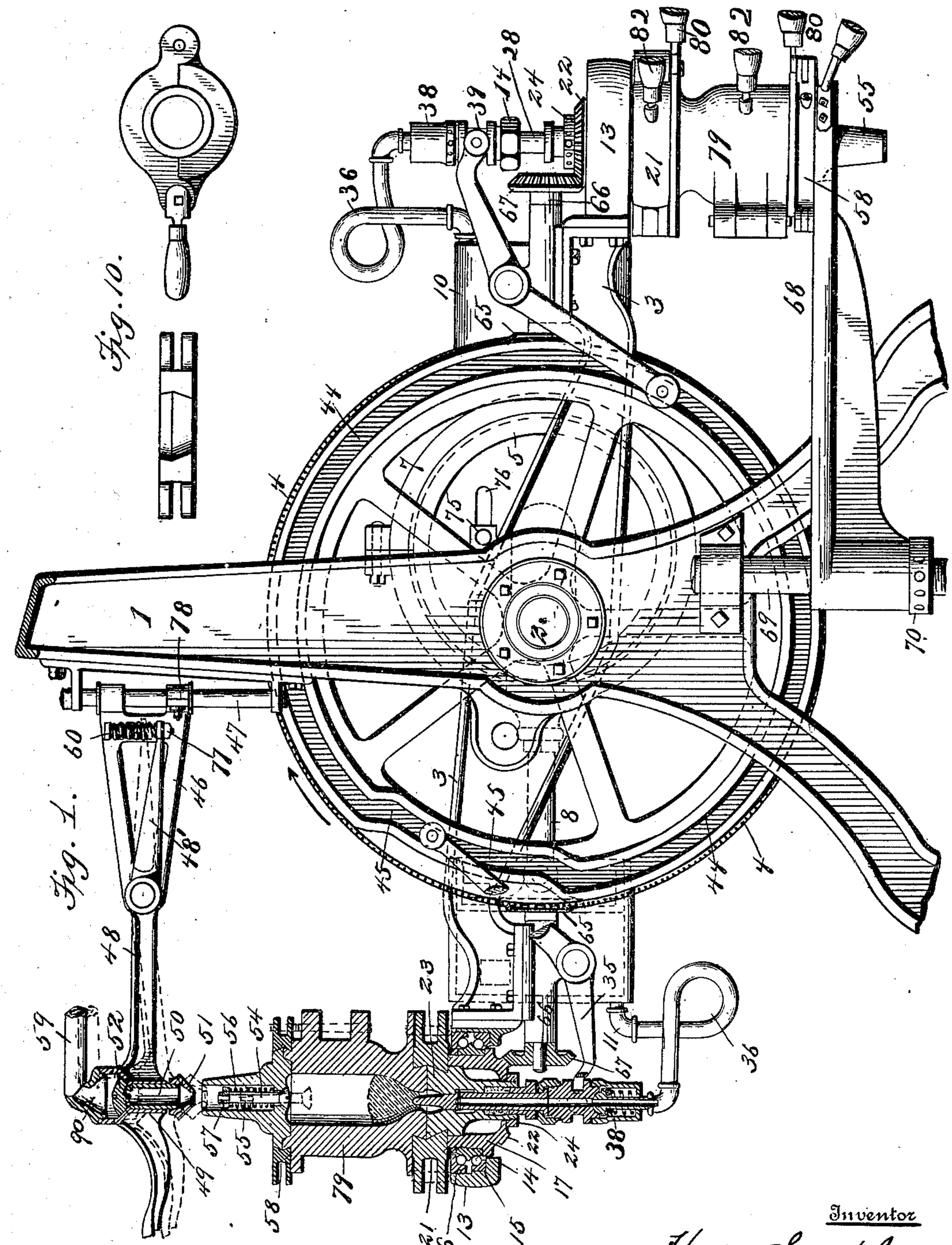

Fig. 1.

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Fig. 12.

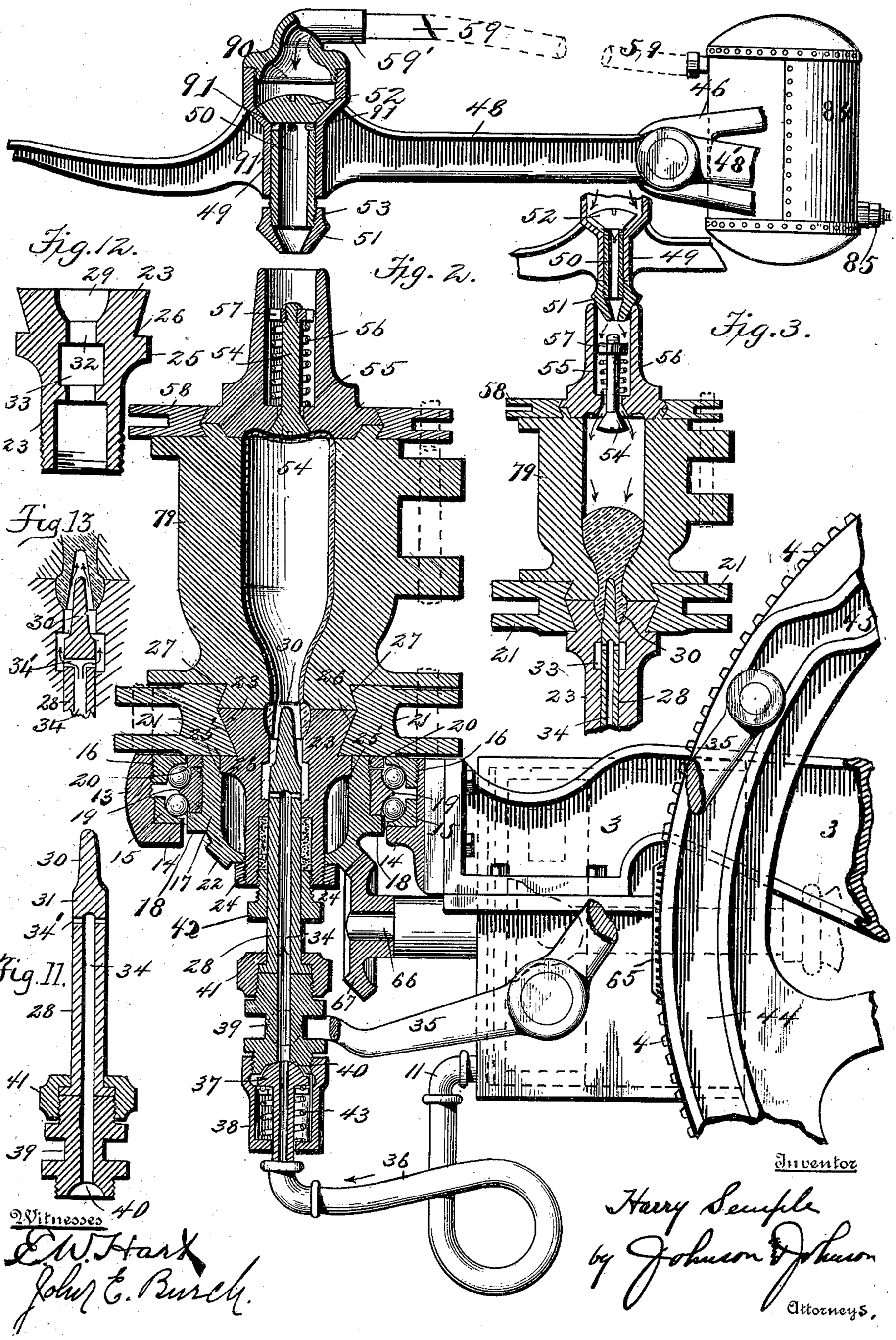

Fig. 2.

Fig. 3.

Fig 13.

Fig. 11.

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Fig. 4.

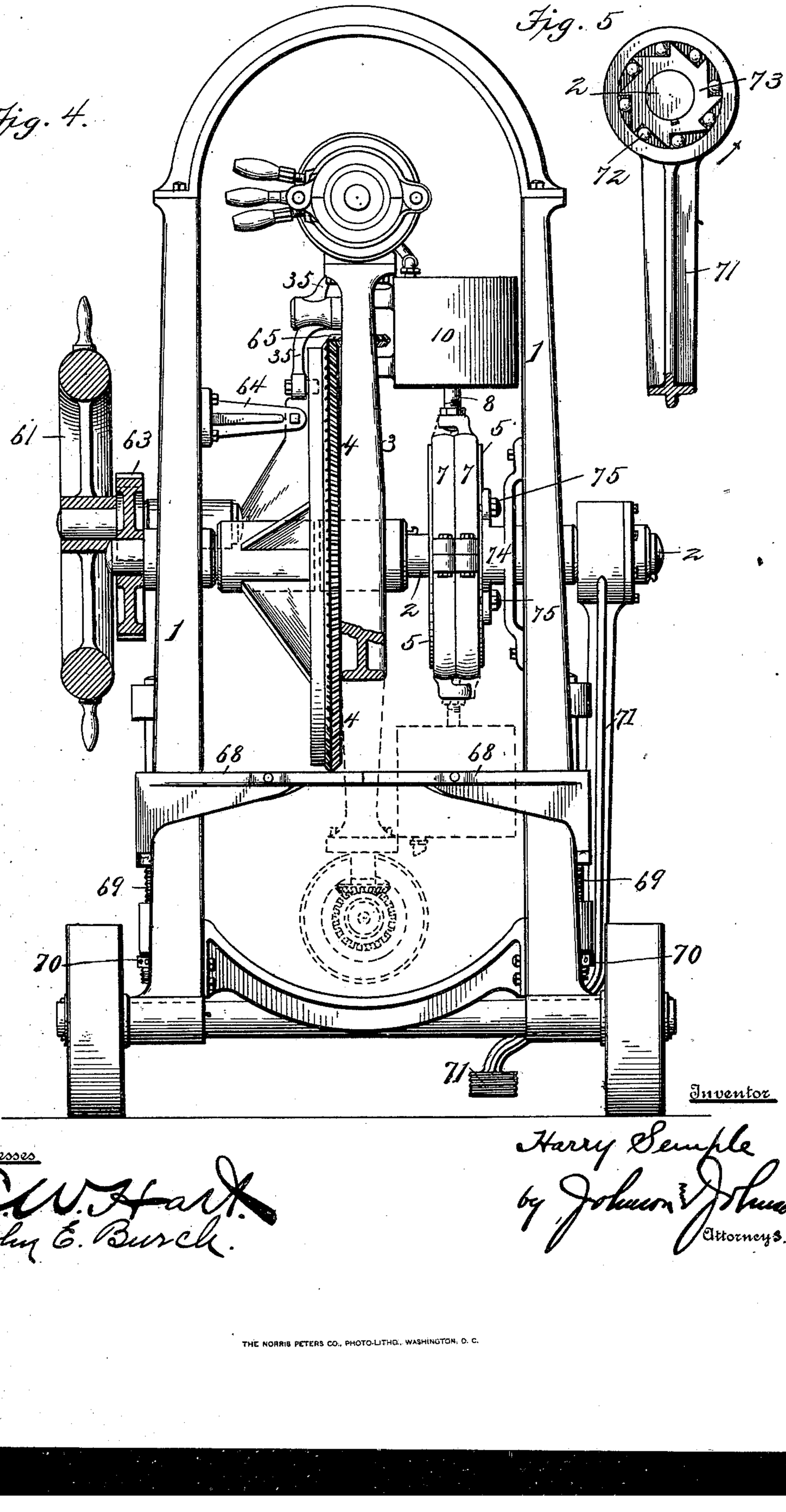

Fig. 5

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Fig. 6.

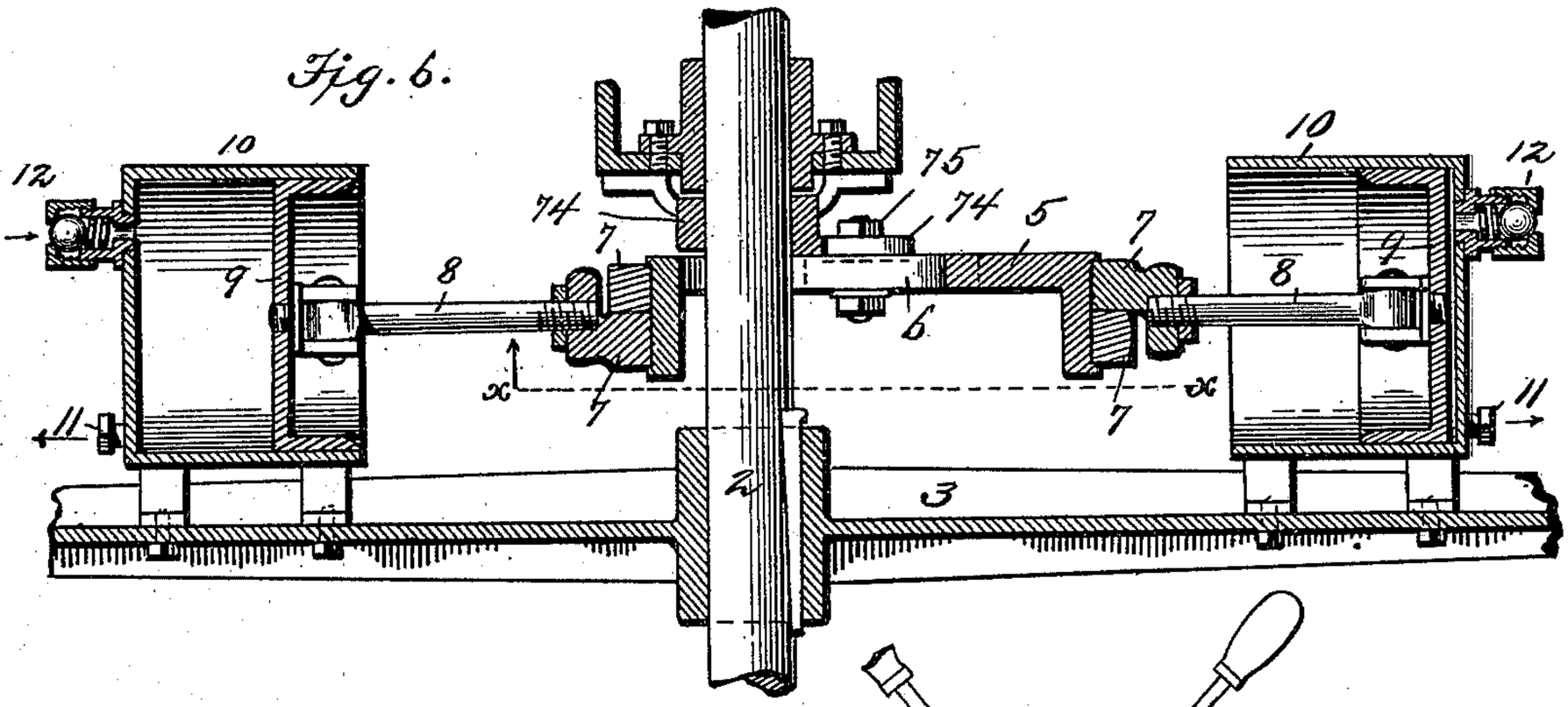


Fig. 7.

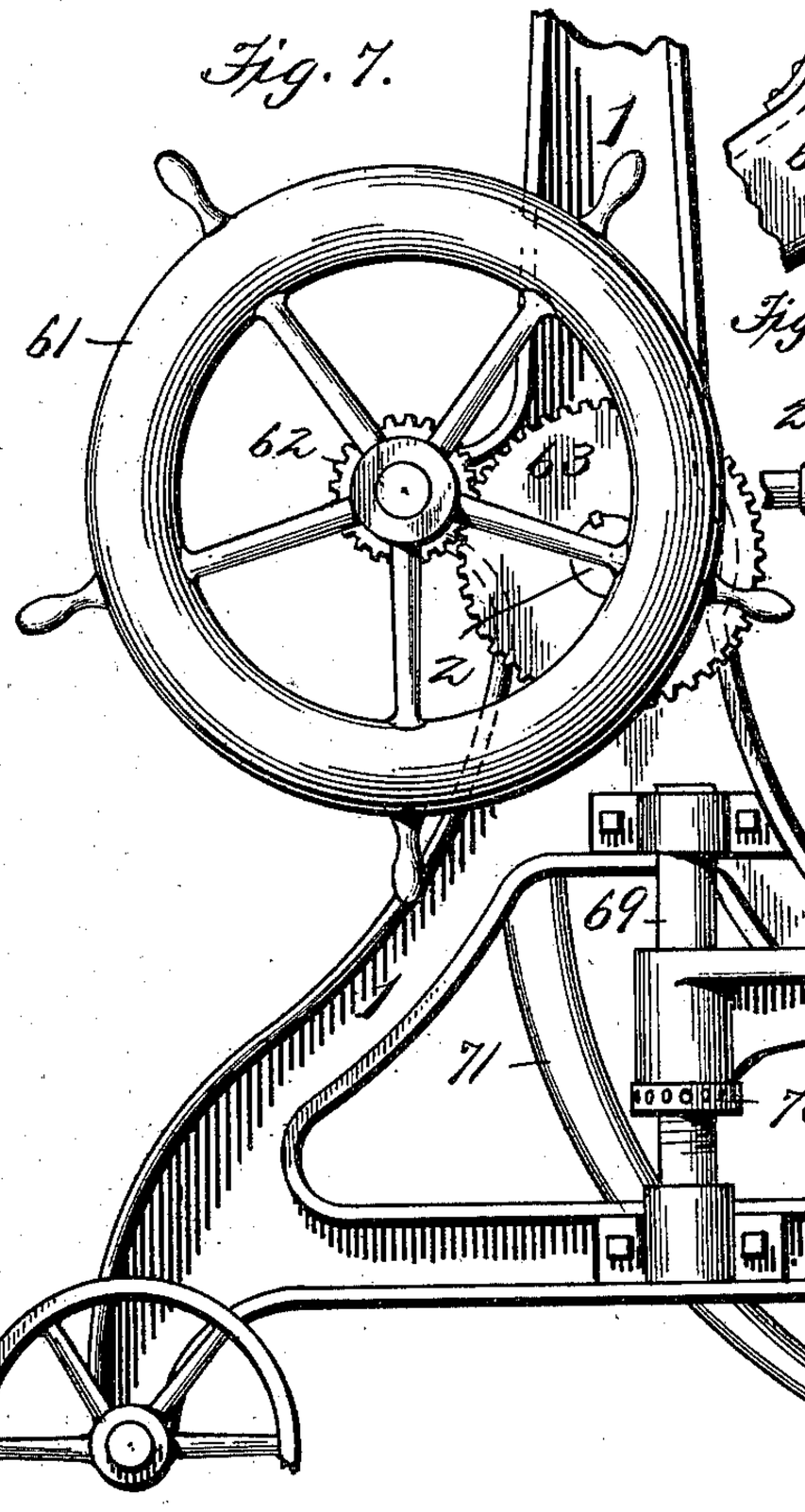


Fig. 9.

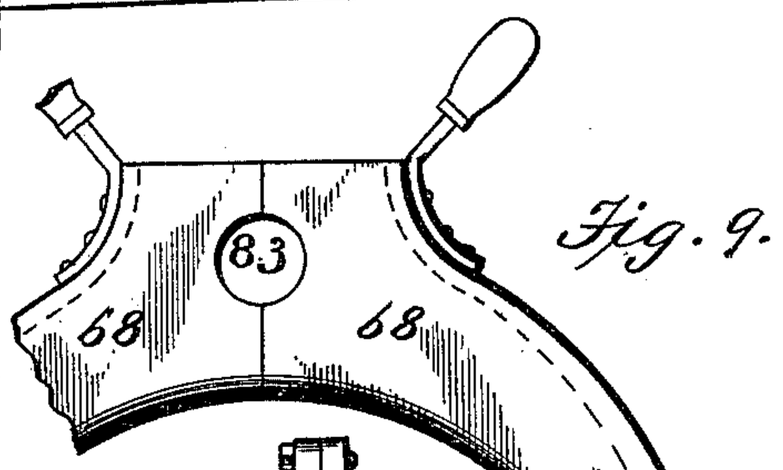
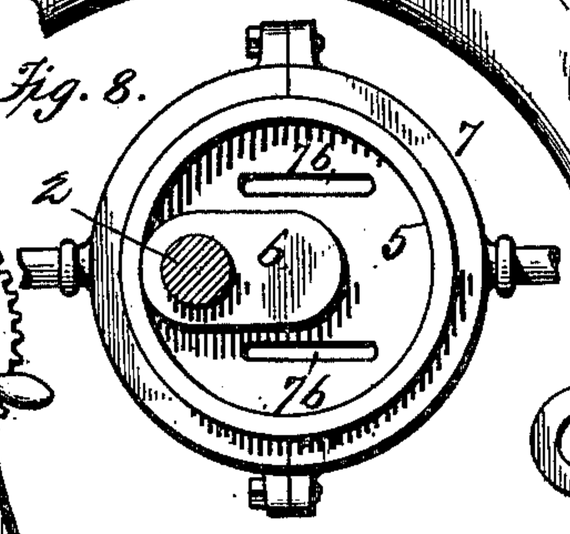


Fig. 8.



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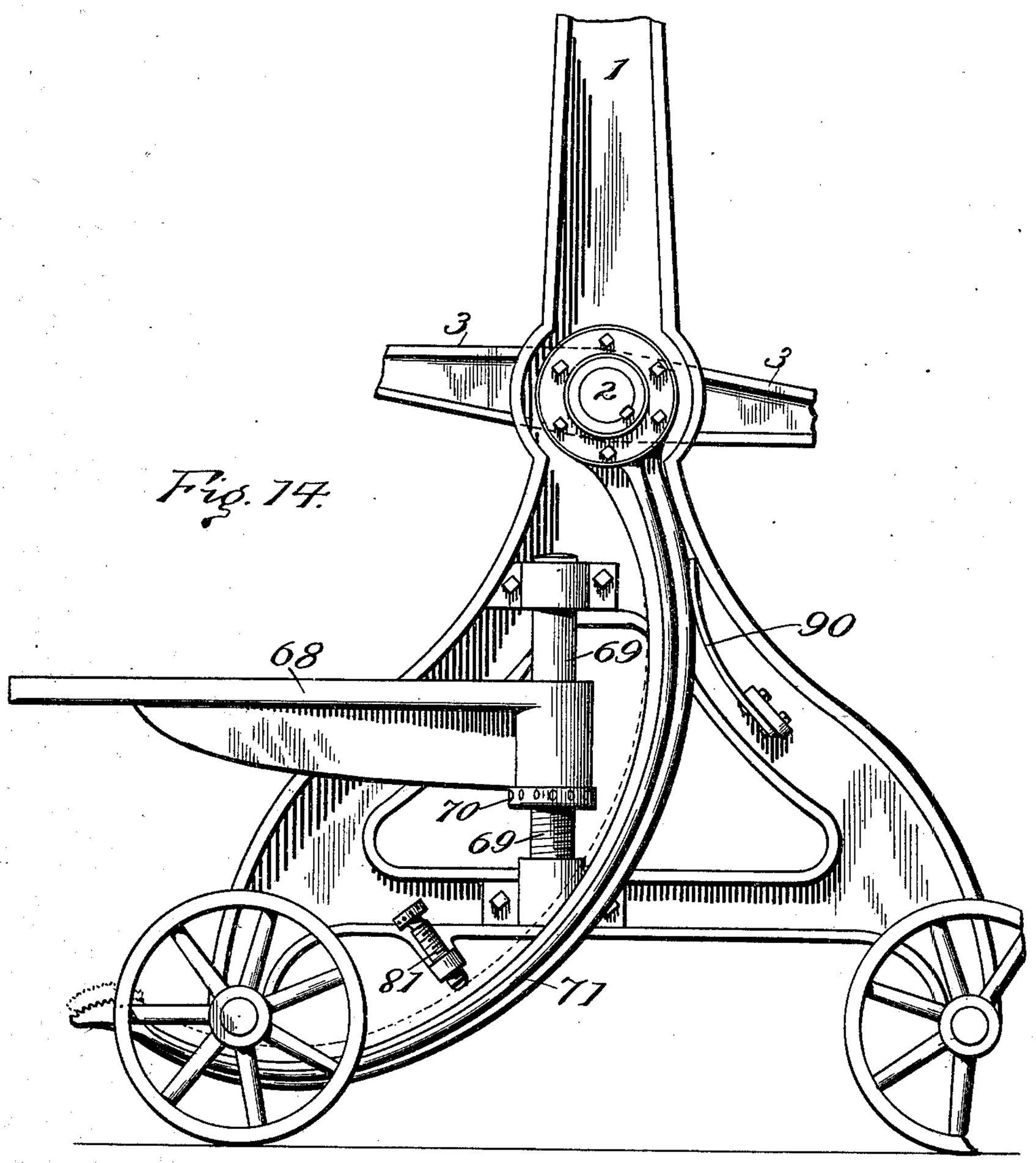
(Application filed Sept. 25, 1900.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 14.



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UNITED STATES PATENT OFFICE.

HARRY SEMPLE, OF WILMINGTON, DELAWARE.

MACHINE FOR BLOWING GLASSWARE.

SPECIFICATION forming part of Letters Patent No. 672,716, dated April 23, 1901.

Application filed September 25, 1900. Serial No. 31,070. (No model.)

To all whom it may concern:

Be it known that I, HARRY SEMPLE, a citizen of the United States, residing at Wilmington, in the county of Newcastle and State of Delaware, have invented certain new and useful Improvements in Machines for Blowing Glassware, of which the following is a specification.

In the statement of my invention in machines for blowing glass articles the following description, read in connection with the accompanying drawings, will enable any one skilled in the art to which my invention relates to understand its nature and to practice it in the form in which I prefer to employ it; but it will be understood that my invention is not limited to the precise form herein illustrated and described, as various modifications and equivalent changes may be made and adapted by the skilled constructor to carry out my invention.

My invention embodies certain novel parts and combinations of parts, which will be particularly pointed out in the claims concluding this specification, and I wish to state that in such particulars many of the devices are not essential to the several features of my invention separately considered. This will be indicated in the claims, as in any given claim the omission of an element or the omission of reference to the particular features of elements mentioned is intended to be a formal declaration of the fact that the omitted elements or features are not essential to the invention therein covered.

As shown, the machine is organized for blowing bottles, but obviously the high-pressure-air device may be employed for blowing other glassware.

Referring to the drawings, Figure 1 represents the machine with its rotating mold-carrying beam in side view, one of the molds, the mechanism for rotating it axially, and the blow-valves at each end of the mold being shown in section in their normal closed positions, the tiller-wheel and gearing for rotating the mold-carrying beam being removed. Fig. 2 is an enlarged sectional view of the mold and its axially-rotating and blowing connections, the coacting valves for blowing by a sudden air-bolt the neck of the bottle through the bottom of the mold being in their closed or inoperative relation to the mold and to the high air-pressure source and the plunger-valve in its open position in the neck of the bottle, which is seen as having been blown and expanded within the mold, and it will be understood that in being so blown the mold will be swung over through a half-circle to an upright position on the table, as seen in elevation in Fig. 1. Fig. 3 shows in section the mold, the coacting valves in operative or open positions to deliver suddenly into the mold air under high pressure to form the neck, which is seen as having been blown in the charge, and the plunger-valve in its closed relation to the neck of the mold and in position to form the blow-hole in the charge preparatory to uncovering the blow-hole to the air, such uncovering being effected by the positive movement of the plunger-valve, as seen in Fig. 13. Fig. 4 is an end elevation of the machine looking from the right of Fig. 1, showing the rotating mold-carrying beam in vertical position, one of the air-compressors removed, and the independent eccentric-strap connections for the pistons of both compressors. Fig. 5 shows the treadle clutch-lever for effecting the release of the mold from the beam to permit the removal of the blown bottle in a way I shall hereinafter describe. Fig. 6 shows in section the rotating mold-carrying beam, the air-compressors thereon, and the eccentric, and, by the rotation of the beam, the piston of one compressor is seen at the limit of its air compressing and displacing stroke and the piston of the other compressor at the limit of its air-suction stroke. Fig. 7 is a side view showing the tiller-wheel and its gear connection with the shaft 2, on which the mold-beam is fixed. Fig. 8 shows the eccentric and its relation free of the shaft 2, taken on the line $x\,x$ of Fig. 6. Fig. 9 shows in top view the pivotally-mounted swing-tables which form a rest and a stop in the operation of arresting the beam to remove the mold having the blown bottle and supporting the beam while blowing the neck of a bottle in the other mold. Fig. 10, Sheet 1, shows the usual split-clamp ring used for the split mold. Fig. 11, Sheet 2, shows the plug-valve with its solid blow-hole-forming point; and Fig. 12 shows the tubular mold-seating plug with its neck-forming cavity and valve-spaces

with which the plunger-valve coacts. Fig. 13 shows the neck blow-hole uncovered; and Fig. 14 shows treadle, its stop, and spring for holding it in its normal position.

The frame in which the operating parts are mounted is preferably carried on wheels to render the machine portable and is composed of side standards 11, connected at their upper and lower ends. About mediately of their height and in suitable bearings in the standards is mounted to rotate a horizontal shaft 2, which carries the operating parts. On this shaft, about mediately of its length, is fixed a beam 3, mediately of its length, and has suitable provision whereby the mold parts and blowing devices are mounted and operated at each end of the beam. To the standard at one side of the beam is fixed a master bevel-gear 4, Fig. 4, so that the shaft and the beam must rotate together and independent of the master-gear. On the other side of the beam an eccentric 5 is suitably fixed on the other standard, so that the shaft passes through a slot 6 in the eccentric; but the latter has no connection with the shaft, as seen in Figs. 6 and 8. Suitably fitted to rotate on this fixed eccentric are two straps 7 7, Fig. 6, side by side, each pivotally connected by a rod 8 to a piston 9. Mounted on the beam at its side, at or near its end, is a trunk-cylinder 10, and within which the pistons are respectively fitted. The piston-rods are of equal length, and their relation to the fixed eccentric is such that the rotation of the beam will give equal strokes to the pistons by reason of the fixed relation of the eccentric to the shaft. This fixed relation of the eccentric and the shaft is such that the eccentric projection is centrally in line with the piston-rods, which therefore are caused to reciprocate as their separate straps are rotated on the fixed eccentric.

Each cylinder has an air-outlet 11, which connects with the mold, and an air-inlet valve 12, so that the beam, which carries a mold at each end, carries also an air-compressor at each end. The preferred arrangement is that the molds shall be on the ends of the beam and the compressors at the side thereof, so as to form a compact relation of the beam, its molds, the compressors, and their operating eccentric. A convenient construction for mounting the molds on the ends of the beam and providing effective means for imparting to them an axial rotation, while at the same time they are rotated with the beam, is best seen in Fig. 2, wherein ball-bearings are provided for the axial rotation of the molds. At its ends the beam terminates in a ring 13, the axis of which is central with the mold and which is preferably bolted to the flanged end of the beam, so that the axis of the ring stands at right angles to the line of the beam, as in Fig. 1. At one of its open sides the ring has an inward-projecting rim or flange 14, upon which is fitted, in the angle against the inner wall of the ring, a concave ring-seat 15. At its other open side the beam-ring has an interior-wall screw-thread to receive a concave ring-seat 16, Fig. 2, the concave sides of the ring-seats being opposite and contiguous, and each forms a raceway-bearing for a train of balls, upon which the base-section of the mold is mounted to rotate. This base mold-section consists of a cup-shaped casting 17, having at one end an external rim or flange 18, matching the internal rim 14, on which a ring 19 is fitted against the outer wall of the said cup and is formed with concave seats matching those of the beam-ring and completing raceways for the ball-bearings on the beam-ring and the cup. A ring-screw 20, engaging the wall of the cup, retains the double concave ring-seat 19 in place upon the flange 18 and the ball-seating parts, and the cup presents a level face-support and seating for a base split-clamp lock 21, whereby the mold is caused to rotate upon the beam-ring. The lower edge of the cup has a cog-gear 22, and centrally within this cup is fitted a tubular plug 23, which projects beyond the cup and forms a lock-seating for the mold and for the clamp 21. The other end of the cup has a ring-screw 24, which, engaging the outer projecting end of the cup, binds the tubular plug, by its circumferential shoulder 25, Fig. 12, upon an annular shoulder-seat 25′ on the inner wall of the cup, Fig. 2. At its mold-seating end the tubular plug has an oblique circumferential undercut 26, which forms an annular shoulder on a plane with the end of the cup to receive the split clamp 21, which has a corresponding oblique part engaging a circumferential undercut 27, formed at the base of the mold, whereby the mold is clamped to and upon the flat end of the tubular plug, Fig. 2.

Within the tubular plug is fitted a tubular stem 28, Fig. 11, which forms a passage for air in blowing the bottle and is slidable to open and to close such air-passage, a plug-valve 31 operating at the mold-seating of the tubular stem for controlling the inlet of the air for blowing the bottle and also forms the initial blow-hole in the charge by a solid point 30.

The tubular plug has an annular cavity 29 in its mold-seating end, Fig. 12, and the mold-chamber is contracted at its seating end, which forms a continuation of the plug-cavity 29, within which the neck of the bottle is blown. Within this cavity the tubular stem-valve terminates in the solid point 30, having a length sufficient to pierce the neck formed on the charge and form a hole therein about an inch, more or less, as in Fig. 3. The hole is preferably made flaring to the mouth of the bottle, so that when the plunger air-tube is withdrawn the hole will be uncovered around the solid point for the passage of the air from the tubular valve into the hole in the neck in the operation of blowing the bottle.

At the base of the point 30 the stem 28 forms the valve 31, which reciprocates in an annular seat-opening 32, Fig. 12, joining the

neck-forming cavity 29 of the mold-seating plug, so that when the stem-point is projected into the neck of the charge, as in Fig. 3, the valve will close the cavity 29 at the mouth of the neck, and thereby cut off the air-passage thereto while the neck and the blow-hole are being formed in the charge. The valve-seat 32 opens into an enlarged part 33 of the plug, into which opens the air-passage 34 of the stem, which communicates with the air-compressor and with the mold by the side holes 34′, Figs. 11 and 13. The plunger-valve stem is open at its lower end and projects a sufficient distance beyond the base-cup 23 for connection with the air-compressor and with a lever 35, by which the plunger-valve is actuated. The stem of the plunger-valve fits closely the walls of the bore of the cup 23, but is free to slide therein, and its outer end terminates in a collar by which it is clamped within and between the screw-couplings 39 41, and it is the coupling part 39 which forms the connection for the lever which reciprocates the plunger-valve which rotates with the mold, the friction of the valve-stem in the bore of the tubular plug 23 and stuffing-box being sufficient to cause such rotation or to allow the tubular cup and the mold to be rotated independently of the air-tube.

The extent of the movement of the plug-valve is limited by the vibration of the lever caused by the deflection in the cam-groove, and as each mold has identical lever connections the cam-groove actuates both levers as the beam is rotated to cause the valve of one mold to be closed and the valve of the other mold to be opened while the molds are standing as in Fig. 1.

The air-compressor connection is made by a rubber tube 36, and in order that such connection will permit of the rotation of the plunger-valve 28 with the mold the rubber-tube connection with the stem of the plunger-valve is made by a ball-and-socket joint. As seen in Figs. 1, 2, and 11, this joint connection is made by the ball-stem 37, fastened to the rubber tube and inclosed in a coupling-nut 38, which is screwed on a screw-section 39, which has a concave seat 40 and is coupled to the plunger-valve by a screw-ring 41, making a seat-joining. The coupling-nut 38 is hollow and is adjustable to give more or less pressure upon the ball-stem. A stuffing-box 42 seals the plunger-valve stem 28 with the base supporting-plug 23, so that the rubber tube allows the plunger-stem to have a longitudinal movement to open and close its valve and for a limited projection into the neck of the mold and a rotary motion with the mold. A spring 43 maintains the sealed contact of the ball-and-socket joint, said spring being seated in the coupling-nut and against the ball-stem 37 for pressing the latter against the valve-stem 34 by the coupling 39.

Referring to Figs. 2, 11, and 12, it must be understood that the tubular valve-stem 28, the tubular plug 23, and the mold are the parts which are rotated together upon the ball-bearings, because they are clamped together upon the seating-gear cup by the shoulder 25′ and the ring-nut 24, while the tubular stem 37 forms the non-rotating part which connects with the air-compressor and affords a free bearing-joint and a free passage for the air in blowing the article. It is important to note that the air-tube, with its blow-hole-forming plug, does not independently rotate, neither does the article being blown independently rotate, because its neck having been first blown into the cavity of the tubular plug and into the neck forming part of the mold which is seated upon and is fixed thereto, and they are therefore rotatable together as an entirety and carry the article being blown with them. This construction allows the blow-hole-forming plug 30 of the air-tube to remain within and rotate with the ball of glass and the mold until the latter has started upon its swing movement, after which the air-tube is withdrawn so as to uncover the blow-hole.

The means for opening and closing the plunger-valve is a cam-groove 44 in the side of the fixed master-gear 4 and a lever 35, pivoted to the end of the mold-bearing beam and engaging the outer end of the plunger-valve by a suitable coupling. This lever travels in the groove 44 with the rotation of the beam, so that a deflection 45 in the groove acts to vibrate the lever, and thereby force the plunger inward and outward to project its solid inner point into and out of the neck of the mold for the two purposes of cutting off the air and forming the initial blow-hole in the lump of glass as a preparatory step in blowing the bottle, Figs. 3 to 13. For this purpose the lever has a clutch connection 39 with the plunger-valve, whereby it is free to rotate with the mold.

The neck of the bottle is blown by an air-bolt projected through the bottom of the mold, which during such operation stands inverted, and the provision for effecting this blowing consists of a pivoted swing-valved device which is in communication with air under high compression and is manipulated by the attendant. This valved device, as shown, consists of an arm 46, mounted to swing horizontally on a rod 47, secured to the standard, and a spring-sustained arm 48, pivoted to the end of the swing-arm, so as to have a vertical movement on said pivot, and having a valve and an independent air-supply connection therefor. This pivoted arm has a tube 49, standing transversely open at both ends, and a tubular valve 50 seated therein, adapted to close the upper end of the tube 49, which has communication with the storage-tank 84 above the valve. This tubular valve 50 terminates at its lower end in a conical formation 51 and is adapted to be opened by contact-pressure applied to its conical end when seated as a stopper in the open end of the

tubular mold-cap 55, so as to lift the closed end 52 of the tubular valve from its seat. This opening movement of the valve 50 is slight and is limited by a shoulder 53, abutting against the lower end of the arm-tube 49, which permits the arm 48 to be held down under slight pressure to seal its communication with the mold-tube when applied thereto. For this purpose the mold is provided with a stem-valve 54, fitted in a tubular base 55, which is seated and clamped upon the bottom of the mold, so as to open centrally into the mold, and within the outer open end of which tubular base the tubular conical end 51 of the air-inlet valve 50 is caused to enter to effect communication of the air-storage tank 84 with the mold, as in Fig. 3. This mold-valve 54 closes the bottom of the mold tubular base by a spring 56, the tension of which need only be sufficient to keep the valve normally closed and is opened by the pressure of an incoming air-bolt on a perforated button 57, fitting the tube on the outer end of the valve-stem. This tubular base 55 is clamped upon the mold by a split ring 58, like that shown in Fig. 10, while the meeting faces of the tubular base 55 and of the mold are such as to interlock them with a sealed joint, which secures the base against the internal air-pressure in blowing the bottle, as in Fig. 2.

The connection of the swing-arm valve 50 with the air-storage tank 84 is made by a rubber tube 59, connected to a branch 59′ of the tubular seating 49 for the valve 50, so that the arm 46 can be swung horizontally into position to be joined with the mold-valve and then depressed vertically to effect such junction by the open end of the valve 50 making contact with the mold-tube 55.

The valve-carrying arm is held normally horizontal by a spring 60 on the swing-arm 46 engaging an extension 48′ of the pivoted arm 48 between the said pivot and the mounting-rod 47 of the swing-arm, so that the arm 48 is depressed against the tension of the spring and raised when released from pressure by said spring.

To limit the downward-pressing action of the spring upon the valve-carrying arm 48 and to hold it in position to instantly set its nozzle or stopper end 51 upon and in communication with the open end of the mold tubular cap 55, the inner end of the swing-arm is pressed by the spring 60 upon a lug 77, fixed on the swing-arm 46, as in Fig. 1.

To properly set the arm 46 so that its horizontal swing will carry the valve-arm 48 above and clear the open end of the tubular cap, the swing-arm is provided with a split clamp 78, by which it may be set higher or lower on the vertical stem 47 to suit different sizes of molds 79. By this construction the limiting of the downward swing of the mold in which the article is being blown will limit the upward swing of the other mold in its relation to the valved swing-arm. Whatever, therefore, the length of the mold, the table and the swing-arm can be relatively set to suit such length to render it easy to place the pivoted valved arm in communication with the mold tubular cap.

The high-pressure valve is fitted closely in the tubular seat, with its upper end forming a solid valve-head 52, closing the seat. The valve-seat opens into a chamber 90, closed by the screw-cap, which connects the flexible tube 59 with the storage air-tank, so that air therein under full pressure is in constant communication with the valve-chamber and keeps the valve closed by such pressure. The communication of this chamber 90 with the tubular passage of the valve is by holes 91 at the junction of the valve-head with the tubular stem, and the valve is opened by lifting it against the pressure of the air in the storage-tank, and when so lifted uncovers the wall-holes and the air from the valve-chamber passes into and through the tubular valve, thereby opens the mold-valve and is projected upon and drives the charge into the desired shape. The provision for this high air-pressure—say about five hundred pounds—not only gives greater volume, but much greater force than the provision for blowing the article through the plunger-valve. Therefore the degree of air-compression in the piston-compressors is less than that in the storage-tank and is a gradually-increasing air-pressure, but must not have undue force to blow the charge into too-thin walls. Moreover, the control of the air in both these blowing operations renders it only necessary to charge the mold to depress the high-pressure-air device to form a junction with the mold-valve and to finish the article while on its way to the point for removal.

It is important to note that the mounting for the swing-arm 46 and the mounting of the mold must be such that the swing movement of the mold will bring it to a point of rest, with its axis in vertical alinement with the axis of the high-pressure tubular air-valved connection, and that the fulcrum of the valved lever-arm must be so located as to allow its tubular valved part to be depressed in a line coincident with the axial line of the mold.

Convenient means for effecting the rotation of the shaft consists of a tiller-wheel 61, mounted on one of the standards carrying a pinion 62, which engages a gear 63 on the end of the said shaft, whereby the mold-carrying beam is rotated intermittently through an arc of half a revolution, at which position it is stopped and seated to allow one of the molds to be filled and the other to be removed for the removal of the blown bottle and the replacement of the mold in the continuous operation of the machine, as I shall more particularly hereinafter state.

The rotation of the mold-carrying beam is utilized as means for effecting the rotation of the mold on its axis while the bottle is being blown, and for this purpose the master-gear 4 is loosely mounted on the shaft adjacent to

the mold-carrying beam and fixed to the frame so that it cannot turn by a bracket 64, fastened to the gear and to the standard, as in Fig. 4. Engaging this master-gear is a pinion 65 on the end of a short shaft 66, mounted in the end of the beam, so as to stand radially with the main shaft, and has a bevel-pinion 67, which engages the bevel-gear 22 on the end of the mold-supporting cup, whereby in rotating the mold-carrying beam the pinion 65 carried by it is caused to roll over the fixed master bevel-gear and be rotated thereby to cause the rotation of the mold during the half-revolution through which its carrying-beam is swung, so that the starting of the swing movement thereby starts the axial rotation of the mold.

I have stated that the mold-carrying beam has an intermittent rotary motion in the operation of blowing and delivering a blown bottle, and referring to Fig. 1 it will be seen that the mold at one end of the beam is in its rotation arrested by a table standing horizontally in the path of the mold. This table consists, preferably, of two shelf parts 68, each mounted to be swung horizontally on a bearing screw-stem 69, fixed vertically on the standards, so that when closed their meeting faces join, Fig. 9, and form a stop to the rotation of the beam and a table on which to support the tubular valved base 55 when unclamped and the mold 19 freed thereby to be separated for removal therefrom to open it to remove the bottle. These shelf parts are made adjustable by nuts 70 on the screw-threaded bearing-stems 69 to allow different lengths of molds to be worked for different-sized bottles.

The swing-arm that carries the high-pressure air-valve can be raised or lowered to accommodate different lengths of molds, and as the rotating beam travels the same distance at all times the handles of the molds will stand in the same place in front of the attendant at the table.

Referring to Fig. 1, the beam has been swung to carry one of the molds to the table for the removal of the blown article and the other mold in position to receive the charge. To remove the mold, with its blown article, the split clamp 21 must be opened by its handles 80 to release its locking connection with the neck-forming plug 23 and with the neck-forming part of the mold. The split clamp 58 is also opened by its handles 80 to release the mold from the tubular base 55, which then rests upon the table. While thus unlocking the mold the beam is held down tight on the mold by the attendant pressing upon the treadle, which acts to lock the shaft by means of the ball and ratchet-clutch connections 72 73, as seen in full lines in Fig. 14. The attendant then releases the treadle, and this end of the beam being freed from the mold will rise by reason of the weight of the mold being charged, carrying the plug 23 away from the neck of the bottle, so that the mold can be drawn out sidewise by its handles 82 from between the tubular base 55, which remains on the table, and the neck-forming plug 23, which remains on the beam. This backward movement of the beam and shaft is limited by the screw-top 81, set in the standard, and this movement is only sufficient to free the beam-plug 23 from the neck of the bottle, the treadle effecting such limit, as seen by dotted lines in Fig. 14. The mold having been replaced upon and locked to the tubular base part 55, the attendant again depresses the treadle, turning the shaft forward to bring the beam-plug 23 down upon the mold, which having been locked to the beam-plug the treadle is released and is normally held out of engagement, in the position shown by dotted lines in Fig. 14, with the shaft-clutch by the spring 90, attached to the standard and bearing upon the treadle-arm, forcing it in its normal position against the stop. The tables are then opened and the beam rotated to carry the replaced mold to the position to be charged in the continuous operation of the machine.

In the action of the clutch it will be understood that the treadle hangs loose upon the beam-shaft, allowing the latter to rotate freely forward, that the ratchet 73 is fixed on the shaft, and that the balls 72 are caused to engage the ratchet-teeth and the treadle-sleeve hub when the treadle is pressed down to turn its clutch-sleeve hub in the direction of the arrow, Fig. 5. In arresting the intermittent swinging rotation of the mold on the table the axial rotation of said mold is thereby stopped and the tubular neck part of the valved base passes through the hole 83, Fig. 9, formed for it between the meeting edges of the swing-table parts. The treadle in its holding function on the beam to allow the mold to be removed therefrom also serves to support the mold at the other end of the beam against the downward pressure of the high-pressure air-lever device upon the mold. It will also be noted that the molds are arranged to stand in opposite directions and substantially at right angles to the beam, so that when one mold is in inverted position to receive the charge the other mold will stand upright at the other end of the beam in position to be opened for the removal of the blown bottle. This arrangement is advantageous as affording a balance to the beam, as each end has identical construction of mold and air-compressor connections and identical gear connections with a central fixed master-gear, whereby each mold is caused to be rotated on its axis.

In operation the mold-carrying beam is stopped and maintained in a horizontal position for charging one of its molds and removing from its other mold the blown bottle, and, referring to Fig. 1, it will be seen that the mold being charged is in an inverted position, while the other mold has been carried over to its table-support on the other side of the machine, with its neck-forming part stand-

ing up. In this position the tubular valved bottom part 55 of the inverted mold is removed and a charge of molten glass from a punty dropped into the open mold upon the solid point 30 of the plunger-valve 28, as shown in dotted lines, and the tubular valved part replaced and locked. This position of the beam brings its cam-grooved actuated lever 35 in the deflected part 45 of the groove 44 so as to lift and hold the plunger-valve with its solid point at the limit of its inward movement into the plug 23, closing it at the end of the neck-forming cavity, which gives sufficient space around the plunger-point to form the bottle-neck. The high-air-pressure valved lever 48 is then swung over the mold and pressed down, bringing its nozzle 51 under pressure closely seated as a stopper upon the upper open end of the tubular base valved part 55, which pressure causes the lever-valve 50 to be lifted, thereby opening communication with the high-pressure air-supply or storage-tank 84, the air-bolt from which instantly depresses and opens the stem-valve 54 and allows the air to be projected with a blow into the mold, striking and driving the molten glass down over the point 30 of the plunger-valve, so as to form in the glass an initial blow-hole, at the same time forming the neck of the bottle, as in Figs. 3 to 13. This is but a moment's work, and the valve-lever is then swung to one side and the tiller-wheel rotated, carrying the mold over and seating it upon the table. This half-circle swing brings the empty mold to the position from which the charged mold started, while at the starting of this swing movement the plunger-valve 28 is withdrawn by the action of the cam-groove 45 upon the lever 35, which connects the stem of said valve, and thereby opens the passage to the mold for the entrance of air into the initial blow-hole. It is during this half-circle swing of the mold that the bottle is blown, and the air for this purpose is furnished by the air-compressor, the piston of which is caused by the action of the fixed eccentric to be forced inward, driving the air out under a gradually-increased pressure through the rubber tube 36, through the plunger-valve, into the blow-hole of the charge of the glass, expanding and forming the bottle around the walls of the mold, as in Fig. 2. The fixed eccentric, while thus forcing the piston into the compressor as the mold is traveling through the half-circle, is at the same time and to the same extent withdrawing the other piston from the other compressor, so that when one mold reaches the position to receive the glass charge the piston of its air-compressor is at the limit of its outward stroke drawing in air, and the piston of the other compressor is at the limit of its inward stroke, having forced out the air, the bottle is blown, and the mold seated upon the table to be removed from the beam. In this way the operation is made continuous, the mold-carrying beam being rotated vertically and the fixed eccentric causing the alternate projection and retraction of the pistons at each revolution of said beam. This relation of the pistons and their relation to the fixed eccentric is seen in Fig. 6, the projection of the eccentric to one side of its shaft being in the line of the piston-rods, and therefore both pistons are at the limit of their strokes when the beam stands horizontal. In this figure is seen how the fixed eccentric has forced the independent strap of each piston-rod to project one piston and retract the other, and this result is obtained by having independent piston connections on one and the same eccentric.

It is important to regulate the pressure of air forced from the compressor to suit different sizes of bottles, and for this purpose I make provision for adjusting the eccentric upon the standard, so as to increase or diminish the extent of the projection of the eccentric at one side of the shaft. To allow for this adjustment of the eccentric, it is secured to the standard by a bracket 74, as seen in Figs. 4 and 6, and the adjustment is made by nutted bolts 75, which pass through arms in the bracket and through slots 76, standing horizontal in the eccentric on each side of the shaft, as in Fig. 8. The eccentric also has a horizontal slot 6, which permits it to be set over the shaft 2, which passes through it, and the eccentric is therefore independent of the shaft. In setting the eccentric for this purpose it is only necessary to loosen the bolts 75 and move the eccentric thereon to either side of the shaft to give the eccentric more or less projection on one side thereof. The greater this projection the longer will be the strokes of the pistons and necessarily an increased pressure of air will be forced from the compressors, and vice versa.

In the blowing operation it is necessary that the mold should be rotated on its axis to give uniform thickness to the walls of the bottle while the mold is being swung upward and over and down to its seating on the table. In these two movements of the mold the blowing is first in an upward direction into the neck of the bottle and terminates in a downward direction, and it is these two axial and swing movements coacting that gives a uniform thickness to the walls of the bottle by counteracting the tendency of the glass to gather on one side of the mold from the force of the swing movement. This swing movement, it will be observed, is rendered comparatively slow by the provision of the tiller-wheel and its pinion engaging a larger gear on the shaft, which rotates and carries the mold-carrying beam, while the rotation of the mold on its axis is rapid, because the master gear-wheel drives the small bevel-wheels 65 and 67, the latter of which engages with the gear 22 of the cup on which the mold is clamped and which is supported by the ball-bearings. As the intermittent swinging rotation of the pair of molds is to render the operation continuous in blowing the article in one mold

while the other is being presented to receive the charge of glass, such continuous operation would produce an imperfect article were it not for the provision for causing the glass to shape itself with uniform thickness within the mold-walls during its swinging movement by the axial rotation of the mold, both movements being uninterrupted from start to finish. In the coöperation of these two movements the starting of the swinging movement of the mold automatically sets in motion its axial rotation, while the arrest of the swinging movement of the mold automatically causes the stopping of its axial rotation, the swing movement being comparatively slow to allow the glass to shape itself around the walls of the mold. The mold operated in this way causes the article to be blown at one and the same operation, in which three forces coact continuously—that is, a blowing force under a gradually-increasing pressure, a centrifugal force due to the axial rotation of the mold, and a swinging movement thereof—each force having a separate and distinct function in the completion of the article. The result of the gradually-increasing pressure of the air is to cause it to have a uniform force in expanding the glass as the latter is caused to fill the mold. In my process the embodiment in an operation of one step of three forces acting as a unit is the confining of air injected under a gradually-increasing pressure into a charge of molten glass, while at the same time the charge is subjected to two continuous simultaneous movements, whereby the air is caused to be directed and to have a central action within the charge, whereby that side of the glass wall which stands toward the direction of the swing movement will be prevented from being blown into a thin wall or away to nothing. The holding of the air central in the ball of glass is the important function of the operation of blowing, rotating, and swinging the mold, and in the art of blowing glass I believe myself to be the first to employ these three forces in their coöperating functions. I have stated that the article is blown under a gradually-increasing air-pressure, and I mean by this that the capacity of the air-compressor is first determined, according to the size of the bottle to be blown, to give the proper volume of air for blowing it, and the treating this limited volume of air by compressing it with a gradually-increasing pressure, so that as the pressure increases the glass expands to take it up, the volume of air being thereby neither increased or diminished. At the moment of the commencement of the overswing of the mold the piston of its air-compressor commences to force air into the mold to blow and expand the glass around its walls, and the air-pressure is gradually increased to cause the glass to be uniformly expanded against the walls of the rotating mold until the mold is seated upon the table, meanwhile the piston returning by the under swing is being retracted, drawing in air till it reaches the point from which the other mold started, and is therefore ready for its blowing function in starting the mold in its overswing movement. In this way the rotation of the mold-carrying beam is controlled by hand by turning the tiller-wheel, which at the same time and by the same movement controls the movements of the air-compressing pistons.

It is important also to note that the air-compressor is in perpetual communication with the tubular plunger-valve and that such communication with the mold is controlled by the plunger-valve at the point where the neck of the bottle is formed.

It is also important to note that the operation of blowing the bottle is commenced while the mold is in an inverted position and is finished during a movement in which the mold is swung over through an arc of half a circle, while the empty mold is by the same swing brought to the position to receive a charge of glass to repeat the operation.

It is only necessary to give the tiller-wheel a few turns to effect the blowing of the bottle during the swing of the mold through half a revolution, and the mold is delivered with its blown bottle with an easy stop upon a table.

The sectional mold, its clamps, and the pivoted table-forming parts are each provided with handles, by which they are opened and closed, as seen in Fig. 1.

In forming the blow-hole in the charge the importance of such hole lies in being uncovered after being formed for the purpose of freely admitting the air therein independent of the plug-valve, which is withdrawn to uncover the neck and hole for this purpose. This construction permits the point of the plunger-valve to be made solid instead of being perforated, as hitherto used, and in which use the blow-hole cannot be uncovered as an initial step in the blowing and expansion of the glass.

The air-storage tank 84 may be conveniently placed near the swing-arm and kept under high pressure from a pump (not shown) by a suitable valved connection 85.

While it is important that the valve which controls the high-pressure air should be opened suddenly to admit air in large volume and under high force to drive the molten glass solidly into the form of the mold, it is equally important that the valve which controls the blowing of the hollow article should be opened and closed slowly to gradually admit and cut off the air, because high-air force under sudden projection is not suited to blowing glass into thin walls. For this reason the ends of the deflected part of the cam-groove are inclined to give a gradual vibration to the lever 35 in passing from the part of the groove which holds the valve closed into the part of the groove which holds the valve open, as seen in Fig. 1. In this way the rotation of the beam causes the plunger-valve of the mold moving to the position to receive the charge to be

opened and the plunger-valve of the other mold to be opened to effect the blowing of the article while the mold is under a compound movement of being rotated on its axis and swung to the position at which the mold is removed for the removal of the blown article.

Referring to the separate and distinct air-pressures, and particularly to the importance of providing different pressures for the two separate blowing operations, it will be seen that the rotation of the mold-carrying beam as a means of actuating the air-compressors serves to create the air-pressure at the time it is needed for blowing the article and by a graduated increasing pressure, and this graduated pressure is produced as follows: As the mold starts on its swing after the neck has been blown the plunger-valve is opened by the action of cam-groove upon the valve-connected arm. The air then enters the blow-hole in the formed neck at a very low pressure, because the eccentric will then be working off the dead-center part. As the beam progresses in its swing the eccentric increases the speed of the air-compressing piston, and therefore increases the pressure for the blowing. The action of the eccentric is such that the air for blowing is gradually increased in pressure, because if the air were let into the mold from a tank of uniform high pressure the glass would be splattered or puffed out in a blister and the centrifugal action on the glass due to the axial rotation of the mold would be without effect.

I claim—

1. In a glass-blowing machine, a mold, means for supporting it, a valved cap for closing the bottom of the mold, and a separate overhanging swing-valved device, having communication with air under high compression, and arranged and adapted to be pressed into connection or engagement with the said valved cap whereby to open communication between the mold and the swing-valved device, to admit a bolt of air upon the charge in the mold.

2. In a glass-blowing machine and in combination with a beam having a mold at each end, of a valve controlling the open-neck end of the mold and a valve controlling its open bottom end, means for opening and closing said valves, means for blowing into each valved end of the mold, and means whereby the mold-carrying beam is rotated.

3. In a glass-blowing machine, a mold, a valve opening inward at its bottom end, a tubular plunger-valve for closing the other end of the mold, means for opening the inward-opening valve, means for opening the plunger-valve, and means for introducing air into the mold under high sudden pressure through the bottom valve and separately and subsequently introducing air under uniform pressure into the mold through the plunger-valve and means for closing both valves.

4. In a glass-blowing machine, a sectional mold, a spring-closed valve at its bottom end and a tubular plunger-valve at its neck end terminating in a solid point, means for projecting said plunger-valve into the neck of the mold to close it and to form a blow-hole in the charge, means for withdrawing said plunger-valve to open it and to uncover the blow-hole, means for forcing air to open the spring-closed valve to form the neck and the blow-hole and means for subsequently and separately forcing air into the mold to form the article, and means whereby the tubular plunger-valve is opened.

5. In a glass-blowing machine, a mold, a tubular cap closing its bottom end, a spring-closed valve in said cap opening into the mold, in combination with an arm arranged to overhang the tubular cap, a valve in said arm having communication with air under high compression and adapted to be engaged or connected with said tubular cap whereby the arm-valve is opened by such engagement and the cap-valve opened against the tension of its spring by the force of the air-bolt into the mold.

6. In a glass-blowing machine, a mold, a tubular cap closing its bottom end and a spring-closed valve in said cap, in combination with an arm mounted over the tubular cap, a tubular valve in said arm having communication with air under high compression, and terminating in a nozzle or stopper adapted to enter the open end of the tubular cap and by pressure upon the arm cause the tubular valve to be opened and thereby open communication of the air under high pressure with the mold.

7. In a machine for blowing glassware and in combination with a beam, a mold on each end thereof arranged to stand in opposite directions at right angles thereto, a tubular valved cap on the bottom end of the mold, means for vertically rotating the mold-carrying beam, a table arranged to arrest the beam and hold it in horizontal position, an arm mounted to swing laterally over one of the molds, and a spring-sustained lever pivoted on the swing-arm, and having a tubular valve perpetually in communication with the supply of air under compression, and adapted to be put in communication with the mold through its valved cap in the way and for the purpose stated.

8. In a glass-blowing machine and in combination with a beam having a mold standing in opposite relation at each end thereof, of a valve controlling the open neck end of the mold, a valve controlling its open bottom end, means for suddenly projecting air into the valved bottom end of the mold, means for rotating the mold on its axis during the rotation of the beam, and means whereby air is forced into the neck valved end of the mold during its rotation on its axis and its rotation with its carrying-beam.

9. In a glass-blowing machine and in combination with a beam having a mold at each end standing in opposite directions, means

for rotating the beam and means for rotating the molds during their swing movement with the beam, means whereby a bolt of air is projected under high pressure into the bottom valved opening of the mold, and means whereby air under a uniform pressure is forced into the open valved neck end of the mold during its compound movement in the way and for the purpose stated.

10. In a glass-blowing machine and in combination with a frame, a shaft mounted thereon, a beam fixed upon said shaft having a mold at each end standing in opposite directions, means whereby air under pressure is forced in successive steps into the opposite ends of the mold, means for rotating the shaft with its beam with a comparatively slow motion, means for rotating the molds on their axis with a comparatively fast motion, and means whereby the bottle is caused to be blown during the compound movement of the mold.

11. In a glass-blowing machine, and in combination with a frame, a shaft mounted thereon, a beam fixed upon said shaft, a mold at each end of the beam standing in opposite directions, trunk-cylinders fixed on the beam in alinement, an eccentric fixed on the frame, a piston for each cylinder having independent strap connection with the eccentric, means for rotating the shaft with its beam and air-compressors upon and over the eccentric, a tubular plunger-valve operating to open and to close the neck of the mold, and means connecting the tubular plunger-valve with the compressors for operation substantially as described.

12. In a machine for blowing glassware and in combination with a frame, a shaft mounted thereon, a beam fixed upon said shaft having a mold at each end standing in opposite directions, trunk-cylinders fixed on the beam in alinement, an eccentric fixed on the frame, a piston for each cylinder having independent strap connection with the eccentric, means for rotating the shaft with its beam and air-compressors, a tubular plunger-valve operating to open and to close the neck of the mold, means for rotating the molds together with their tubular plunger-valves, a flexible tube connected to each air-compressor, and a ball-and-socket joint connecting the flexible tube with said tubular plunger-valve, in the way and for the purpose stated.

13. In the machine for blowing glassware and in combination with a frame, a shaft mounted thereon, a beam fixed upon said shaft having a mold at each end standing in opposite directions, trunk-cylinders fixed on the beam in alinement, an eccentric fixed on the frame, a piston for each cylinder having independent strap connection with the eccentric, a tiller-wheel and gear connecting the shaft for rotating the beam, a tubular plunger-valve operating to open and to close the neck of the mold, means for rotating the molds together with their tubular plunger-valves, consisting of the fixed master-gear, a shaft mounted in alinement at each end of the beam having a pinion engaging the fixed master-gear, and a pinion engaging a pinion on the mold-seating device, a flexible tube connecting each compressor, with the plunger-valve, and means for reciprocating the latter.

14. In a machine for blowing glassware, and in combination with a frame, a shaft mounted thereon, a beam mounted on the shaft having a mold at each end, trunk-cylinders fixed on the beam in alinement, an eccentric fixed on the frame, a piston for each cylinder having independent connection with the eccentric, means for rotating the shaft with its beam and air-compressors upon and over the fixed eccentric, a tubular plunger operating to open and close the neck of the mold, a master-wheel fixed on the frame, pinions mounted on the beam, arranged to engage the fixed master-gear and a pinion on the mold, a cam-groove on the master-gear, and a lever engaging said cam-groove and the plunger-valve for reciprocating it, and means connecting the compressors and the said plunger-valves for operation as described.

15. In a glass-blowing machine, and in combination with a beam having a mold at each end, a valved air-inlet at the bottom end of the mold and means whereby the mold-carrying beam is rotated, of means for introducing air under high pressure into the mold valved inlet, means whereby the bottle is blown from the neck end of the mold, and means whereby the rotation of the mold-beam is arrested to deliver the blown article.

16. In a glass-blowing machine and in combination with a beam having a mold at each end, a valved air-inlet at the bottom end of the mold, and means whereby the mold-carrying beam is vertically rotated, of a horizontal swing-valved arm overhanging the mold and having communication with air under high compression and adapted to be put in communication with the said mold valved air-inlet, and a horizontal table whereby the rotation of the beam is arrested and held in position to deliver the mold containing the blown bottle for the removal of the latter.

17. In a glass-blowing machine and in combination with a beam having a mold at each end, of a valve controlling the neck end of the mold, and a valve controlling its bottom end, means for blowing into each valved end of the mold, means whereby the mold-carrying beam is rotated, and a table whereby such rotation is arrested consisting of hinged-shelf parts arranged to be closed in the path of the mold, and to support the same in the way and for the purpose stated.

18. In a machine for blowing articles of glassware, a rotating beam, a mold on each end thereof standing in opposite directions, a stop to limit the rotation of the beam, in combination with means actuated by such rotation for blowing the article.

19. In a glass-blowing machine, a rotating

beam, a mold on each end thereof standing in opposite directions, a stop to limit the rotation of the beam, a trunk-cylinder at each end of the beam, a piston for each cylinder, a fixed eccentric for actuating both pistons, means for rotating the beam, in combination with means for actuating the pistons by such rotation and means actuated by such beam rotation for blowing the article.

20. In a glass-blowing machine, a mold, a rotating support for the same, a tubular plunger-valve terminating in a solid finger to operate in the neck end of the same, an air-tube connected to said plunger-valve, in combination with means whereby the latter is caused to rotate with the mold and to have a reciprocating movement in the neck end thereof.

21. In a glass-blowing machine, and in combination with a sectional mold, a rotating support for the same consisting of a tubular seating-plug, a cup, a ring-seat and ball-bearings between the inner walls of the latter and the outer walls of the cup as a mounting therefor, means for clamping the tubular plug upon the inner walls of the cup and means whereby the mold is locked and clamped upon the tubular plug and upon the end of the cup.

22. In a glass-blowing machine, and in combination with a sectional mold, a plug-seating support therefor, a cup and a mounting of ball-bearings therefor, means for clamping the tubular plug upon the inner walls of the cup, a split clamp for securing the mold upon the end of the cup and upon the tubular plug, means whereby the tubular plug is clamped upon the inner walls of the cup, a gear upon the other end of the cup, a tubular-valved plug passing through the tubular plug, means for rotating the mold on its axis, and means for blowing the article through the valved plug.

23. In a machine for blowing glass and in combination with a mold and means for blowing air, a spring-closed valve within one end thereof, a cam-actuated valve within the other end, and means whereby the spring-closed valve is opened by air-pressure.

24. In a machine for blowing glass articles and in combination with a mold, a valve at each end thereof, and means for inwardly opening the neck-blowing valve and means for outwardly opening the body-blowing valve.

25. In a machine for blowing glass articles, a tubular plunger-valve terminating in a solid finger, at the base of which the tubular valve opens, and means whereby said finger is automatically projected into and withdrawn from the neck of the mold, a tubular plug having a cavity at its upper end corresponding in form to the mouth end of the bottle, a valve-seating 32 below and joining said cavity and an annular space 33 below and joining the valve-seating and into which space the valve opens below its finger, whereby the air passes from the valve-stem into the plug below the valve-finger.

26. A machine for blowing glass articles having in combination a frame, a shaft mounted therein, a beam mediately mounted on the shaft, a seat at the opposite ends and on the opposite sides of said beam, a mold mounted on each seat, means carried by the shaft and by the beam for axially rotating the molds, means carried by the frame and by the shaft whereby the mold containing the charge is caused to have an overhead swing, and means carried by the beam and by the frame for blowing the article while the mold is being both rotated and swung overhead from the point at which the mold is charged to the position at which the blown article is delivered, the two movements of the mold being simultaneous and coöperating to prevent irregular thickness in the glass walls.

27. In a machine for blowing glass articles and in combination with a frame, a shaft mounted to rotate therein, a beam fixed on the shaft having a mold at each end, a table-stop to limit the rotation of the beam, means for rotating the beam to deliver the molds in succession upon the table, and a treadle-clutch device mounted on the shaft adapted to lock and hold the beam when separated from the mold in the way and for the purpose stated.

28. In a glass-blowing machine and in combination a frame, a shaft mounted to rotate therein, a beam fixed on the shaft having a mold at each end, an air-compressor fixed on each end of the beam, means whereby each compressor is made to have communication with its coacting mold, an eccentric fixed on the frame and means for independently connecting each air-compressor with the eccentric for operation as described.

29. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a beam fixed on the shaft, a mold and an air-compressor for each mold in communication and fixed on each end of the beam, means for rotating the shaft and means between the compressors for operating them during such rotation.

30. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a pair of molds carried thereby in alinement one at each side of the shaft, an air-compressor for each mold also carried by the shaft, a piston in alinement for each compressor, a non-rotating eccentric, straps connecting it to the pistons, and means connecting the compressors with the molds for operation as described.

31. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a pair of molds carried by and in alinement one on each side of the shaft, an air-compressor for each mold also carried by the shaft, a piston for each compressor, a non-rotating eccentric, straps connecting it to the pistons, means connecting the compressors

with the molds, and means whereby the eccentric is adjusted to project more or less from one side of the shaft to vary the stroke of the compressor-pistons for the purpose stated.

32. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a pair of molds carried by and in alinement one on each side of the shaft, an air-compressor for each mold also carried by the shaft, a piston for each compressor, means connecting the compressors and the molds, a non-rotating eccentric having a central slot through which the shaft passes, a pair of straps on the eccentric—one connecting each piston, and means for adjusting the eccentric in line with the pistons to increase or diminish its projection from one side of the shaft, consisting of a pair of slots in the eccentric on each side of the central slot, a bracket fixed to the frame and nutted bolts engaging the pair of slots and the said fixed bracket whereby the eccentric may be moved over the shaft to increase or diminish the stroke of the pistons for the purpose stated.

33. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a beam fixed on the shaft, a mold and an air-compressor for each mold in communication with each other and fixed on each end of the beam, and a table consisting of a part pivotally mounted on each side of the frame arranged and adapted to be swung horizontally in meeting relation in the path of the mold, whereby to form a stop and a seat for the mold, in the way and for the purpose stated.

34. In a glass-blowing machine and in combination, a frame, a shaft mounted to rotate therein, a pair of molds carried by and in alinement one on each side of the shaft, an air-compressor for each mold also carried by the shaft, a piston for each compressor, means connecting the compressors with the molds, and means whereby the pistons are reciprocated together to force air alternately into the molds.

35. In a glass-blowing machine and in combination with a mold, having a valved opening in its bottom end, an arm mounted to swing laterally, a lever-arm having a valve and pivotally mounted on said swing-arm, to have a vertical movement whereby to bring its valved part into conjunction with the mold valved part, a storage-tank for air under high compression and means whereby said storage-tank is in perpetual communication with the valve of the said lever-arm for the purpose stated.

36. In a glass-blowing machine and in combination with a mold having a valve-opening therein, an overhanging lever-arm device, a valve therein, and a storage-tank for air under high pressure in perpetual communication with the arm-valve, the latter carried in position to be opened by pressure of the lever-arm upon the valved end of the mold whereby the two valves are opened at the same time to open communication of the mold with the storage-tank.

37. In a glass-blowing machine and in combination with a mold having a valve-opening therein, an overhanging lever-arm device, a tubular valve seated in the chamber in the latter, open at its lower end, a storage-tank for air under high compression in perpetual communication with said valve-chamber, and means whereby the lever-arm is carried to allow its tubular valve to be put by pressure in communication with the mold and with the storage-tank.

38. In a glass-blowing machine and in combination, with a mold, means for rotating it on its axis, a tubular plunger-valve rotatable with said mold operating to open and to close its neck-forming end, means for reciprocating said plunger-valve, an air-compressor, a flexible tube connecting the tubular valve and the air-compressor, and a spring-sustained tubular joint-forming stem connecting by sealed joint the tubular valve-stem and the flexible tube, whereby to maintain communication of the rotating plunger-valve with its non-rotating air-compressor connection.

39. In a glass-blowing machine and in combination a frame, a shaft mounted therein, a beam mediately mounted on the shaft, a pair of molds carried in alinement one on each end of the beam each having a valve in its bottom end, means for rotating the beam, a table extending horizontally on one side of the shaft whereby to form a stop to arrest the rotation of the beam and form a seating for the mold, a lever-valved device mounted to extend horizontally over the mold on the other side of the shaft, a storage-tank for air under high compression, and means connecting it with the valve of the said overhanging lever device, whereby one mold is seated upon the table, and the other presented to the overhanging lever-valved device for operation in the way described:

40. In a glass-blowing machine and in combination, a frame, a shaft mounted therein, a beam mediately mounted on the shaft, a mold on each end of the beam, each having a valve in its bottom end, means for rotating the beam, a horizontal table on one side of the shaft, a lever-valved device overhanging the mold on the other side of the shaft, a storage-tank for air under high compression, means connecting it with the valve of the overhanging lever-valved device, means for adjusting the table vertically in relation to the mold and means for adjusting the overhanging lever-valved device vertically in relation to the table, for the purpose stated.

41. In a machine for blowing glass and in combination with a mold having a valved opening at each end, a device constructed to make pressure-contact with one valved end of the mold and thereby open said valve and deliver therein suddenly air under high pressure, means whereby the valve at the other

end of the mold is caused to open gradually to deliver therein air under less pressure and means independent of each valve for supplying the different air-pressures for the purpose stated.

42. In a machine for blowing glass and in combination, a frame, a beam, a mold on each end of the beam, a valve in one end of the mold opening inward, a valve at the other end of the mold opening outward, a device constructed to make pressure-contact with and thereby deliver suddenly upon the valve opening inward air under high pressure, a lever connected to the outward-opening valve, a cam connected to said lever having a construction adapted to gradually open said lever-connected valve, means for supplying air under high pressure to the valve opening inward and means for supplying air under less pressure to the valve opening outward for the purpose stated.

43. In a machine for blowing glass and in combination with a mold having a tubular end, a tubular valve matching the tubular end of the mold, means whereby it is carried and depressed in contact with said mold end to cause said tubular valve to be opened and a storage-tank in communication with said tubular valve.

44. In a machine for blowing glass and in combination with a mold, a tubular plunger-valve for opening and closing the neck end of the mold, means for reciprocating said valve, means for rotating the mold on its axis, a non-rotating tubular device forming an air-tight joining with the valve-stem, a flexible tube connected to the non-rotating device and an air-compressor connected to said tube, whereby the valve is free to be reciprocated and to rotate with the mold, for the purpose stated.

45. In a machine for blowing glass and in combination with a beam, means for rotating it, a mold on each end of the beam, a tubular plunger-valve for opening and closing one end of each mold, a lever pivotally mounted on each end of the beam and engaging the stem of each valve, and a groove-cam having a fixed relation to and engaging both levers and adapted to close the valves of the molds in succession during the rotation of the beam.

46. In a machine for blowing glass and in combination with a beam having a tubular valved open end, of a device for projecting air under high pressure into the mold, consisting of a pivotally-mounted device having a hollow walled part open at both ends, one end terminating in a chamber, a storage-tank for air in perpetual communication with said chamber, a tubular valve seated in said chamber, closing it against the air-pressure and terminating in a depending nozzle adapted to be inserted by pressure into the open valved end of the mold and to form a stop to limit the opening of the valve by such pressure for the purpose stated.

47. In a machine for blowing glass and in combination, a beam, a mold mounted on each end thereof standing in opposite directions therefrom, means for rotating said beam, a table support and rest, means for vertically adjusting it in relation to the mold at one end of the beam, an overhanging high-pressure air device, means whereby it is depressed under pressure for contact and communication with said mold, and means for vertically adjusting the overhanging device in relation to the mold, substantially as and for the purpose specified.

48. In a machine for blowing glass and in combination with a beam, a mold and a piston air-compressor both mounted on each end thereof, means for rotating the beam, means actuated by such rotation for simultaneously controlling the movements of the air-compressing pistons, and means whereby the said air-compressors are caused to have communication with the molds.

49. A machine for blowing glass having in combination a shaft, a beam mounted thereon, a mold on the end of the beam, means for vertically rotating the beam, means for rotating the mold on its axis, means for blowing the article during the axial rotation of the mold, an air-compressor on the beam and means for actuating the air-compressor by the rotation of the beam.

50. A machine for blowing glass having in combination a shaft, a beam mounted thereon, a mold mounted on the end of the beam, means for vertically rotating the beam, means for rotating the mold on its axis, means for blowing the article at one end of the mold, an air-compressor on the beam, means for blowing the article at the other end of the mold, and means for actuating the air-compressor by the rotation of the beam.

51. In a machine for blowing glass, and in combination with a frame, a shaft mounted to rotate therein, a beam fixed on the shaft, a mold seated on each end of the beam, a table-stop to limit the rotation of the beam, means for rotating the beam to deliver the molds in succession upon the table, means whereby the mold is removed from the beam, a treadle device mounted on the shaft, an adjustable stop and a spring both on the frame and coacting with the treadle-clutch device in the way and for the purpose stated.

52. In a glass-blowing machine, and in combination with the mold, of a mounting therefor comprising a tubular plug having a neck-forming cavity, a circumferential flange or shoulder, a cup having an inner-wall seating-shoulder for the plug-shoulder, a carrying-beam having an end ring, ball-bearings seated upon the inner wall of the beam-ring and upon the outer wall of the cup, a nut binding the plug and the cup together at their shoulder-seating means whereby the mold is locked upon the plug and upon the cup, and means for rotating the mold.

53. In a glass-blowing machine and in combination with a mold, of a mounting therefor

comprising a tubular plug having a neck-forming cavity, a circumferential flange or shoulder, a cup having an inner-wall seating-shoulder for the plug-shoulder, a carrying-beam having an end ring, ball-bearings seated upon the inner wall of the beam-ring and upon the outer wall of the cup, a nut binding the plug and the cup together at their shoulder-seating, means whereby the mold is locked upon the plug and upon the cup and means for rotating the mold consisting of a gear upon the bottom of the cup, a gear on the beam and means for actuating the beam-gear.

54. A machine for blowing bottles having in combination a mold, means for blowing the neck of the article while the mold is at rest, means whereby the mold is both rotated on its axis and swung overhead through an arc of half a circle at the same time, means for blowing air into the other end of the mold and means whereby the overhead swing movement is caused to actuate the air-blowing mechanism to complete the blown article.

55. A machine for blowing glass having in combination a mold, means whereby it is caused to have an axial rotation, means whereby it is caused to have an overhead swinging movement through an arc of half a circle during such rotation and means whereby during such overhead swing air under compression is supplied to blow the article into form, the overhead swinging of the mold serving to automatically start the blowing, continuously maintain it during such swing and causing such air-pressure to terminate at the ending of the swing.

56. A machine for blowing glass having in combination a mold and an air-compressor both mounted upon one and the same carrier, means for vertically rotating the carrier, means for connecting the mold and the air-compressor and means for actuating the latter by the rotation of the carrier.

57. A machine for blowing glass having in combination a mold and an air-compressor both mounted upon one and the same carrier, means for vertically rotating the carrier, means for actuating the compressor by such rotation, means whereby communication is effected between the compressor and the mold and means whereby such communication is opened and closed by the rotation of the carrier.

58. A glass-blowing machine having in combination a beam mounted to rotate vertically, a mold, a tubular plunger-valve having communication with the mold, an air-compressor having communication with the valve, means connecting the beam and the valve for actuating the latter, these several parts mounted upon the beam and combined with means whereby the beam is rotated, means whereby the air-compressor is actuated and means whereby the plunger-valve is actuated during the rotation of the beam.

59. A machine for blowing glass having in combination means whereby a gradually-increasing air-pressure is provided consisting of a cylinder, a piston therein, a carrier for the cylinder, a fixed eccentric connecting the piston and means for vertically rotating the carrier and with it the piston on the eccentric, in combination with a mold, a plunger-valve, means connecting the latter and the air-compressor, and means for actuating the valve, the relation of the valve-actuating means and the piston being such that on rotating the carrier the air-pressure will be at its minimum at the beginning of the inward movement of the piston, and the opening of the valve and the maximum pressure will end at the termination of the rotation of the carrier, the inward stroke of the piston and the closing of the valve.

60. A machine for blowing glass having in combination a mold, means for introducing air at one end of the mold consisting of a hand-operated valve and an air-containing tank, put in communication with the mold to introduce air therein under high pressure, means for introducing air into the other end of the mold consisting of a piston air-compressing device in perpetual communication with the mold, and an eccentric having a fixed connection with the piston, and means for causing the mold to be rotated around the eccentric the relation of which to the piston being such as to give increased speed to the piston during such rotation and thereby a gradual pressure to the air forced into the mold.

61. In a machine for blowing glass and in combination with a beam mounted to rotate vertically, a pair of molds one mounted on each end of the beam, an air-compressing device for blowing the article consisting of a trunk-cylinder on each end of the beam, having a valved inlet and an outlet for air, a piston for each cylinder, a fixed eccentric between the cylinders, straps and piston-rods connecting the eccentric and pistons, means for conducting the compressed air from the cylinders to the molds, and means for rotating the beam to cause the rotation of the piston-rod connections over the eccentric, thereby alternately operating the pistons to compress and discharge the compressed air from the cylinders into the molds.

62. A machine for blowing glass having in combination a mold, means for rotating it, means for swinging it overhead through an arc of half a circle and means for blowing the article actuated by the overhead swing movement of the mold.

63. In a machine for blowing glass articles and in combination with a mold, a valve carried by and operative within each end thereof, a cam for opening and for closing one of said valves the other being opened by air-pressure and means whereby air is supplied to each valve.

64. In a machine for blowing glass, a mold, a seating therefor and an air-tube terminating in a solid plug whereby to form a blow-

hole in the glass, and means whereby the mold, its seating and the air-tube are mounted to rotate in the line of mold-axis as an entirety with the article being blown.

65. In a glass-blowing machine and in combination with a mold, means for imparting axial rotation thereto, means whereby the mold is swung through an arc while being rotated, an air-compressing cylinder, means for connecting the air-compressor and the mold, and means for gradually increasing the air-pressure therein in blowing the article during the swinging movement of the mold.

66. In a glass-blowing machine and in combination with a pair of molds, means for imparting axial motion thereto, means for swinging each mold through an arc of half a circle, an air-compressing cylinder for each mold, means whereby the air-compressors and molds are connected, means whereby the air-blowing force is gradually increased in pressure in one mold during its swinging movement, and means whereby air is drawn into the other compressor during its swinging movement for supplying air to the other mold in the continuous operation of blowing the article in one mold and presenting the other to receive the charge.

67. In a glass-blowing machine and in combination a pair of molds, a pair of air-compressors, means for connecting the air-compressors and the molds, means whereby the molds and air-compressors are caused to rotate together, and means whereby the pistons are actuated with equal strokes by such rotation, the one for injecting air under compression into the acting mold, the other for filling the non-acting compressor

68. In a glass-blowing machine and in combination a pair of molds, a pair of air-compressors, a piston for each air-compressor, means for connecting the air-compressors and the molds, means whereby the molds and the compressors are caused to rotate together, means whereby the pistons are actuated with equal strokes by such rotation, the one for injecting air under a graduated compression into the acting mold, the other for filling the non-acting compressor, a tubular air-valve for each mold for controlling the connections of the compressors and the molds, and means whereby one valve of one mold is caused to be opened and the corresponding valve of the other mold is caused to be closed.

69. In a glass-blowing machine and in combination a pair of molds, a pair of air-compressors, means for connecting the air-compressors and the molds, means whereby the molds and the air-compressors are caused to rotate together with an intermittent swing movement, means whereby the pistons are actuated with equal strokes by such intermittent rotation, a tubular air-valve for each mold for controlling the connections of the compressors and the molds, means whereby each air-compressor is in perpetual communication with each tubular valve, and means whereby the latter is actuated.

70. In a glass-blowing machine a mold, a seating therefor and a tubular valve-stem for supplying air to the mold, in combination with means whereby these several parts are rotated as an entirety with the article being blown, and a cam-actuated lever connected to the tubular valve-stem for supporting it within the mold-seating and caused to control the blowing of the air into the mold.

71. In a glass-blowing machine a mold, means for imparting thereto an axial rotation, means whereby it is caused to have a simultaneous rotation at right angles to the axial rotation, means for blowing the article during such combined movements of the mold and means whereby the article being blown is caused to rotate as an entirety with the mold.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY SEMPLE.

Witnesses:

A. E. H. JOHNSON,

LULU P. STROUD.