(No Model.) 5 Sheets—Sheet 1.

H. J. COLBURN.

GLASS BLOWING MACHINE.

No. 584,755. Patented June 15, 1897.

Fig. 2.

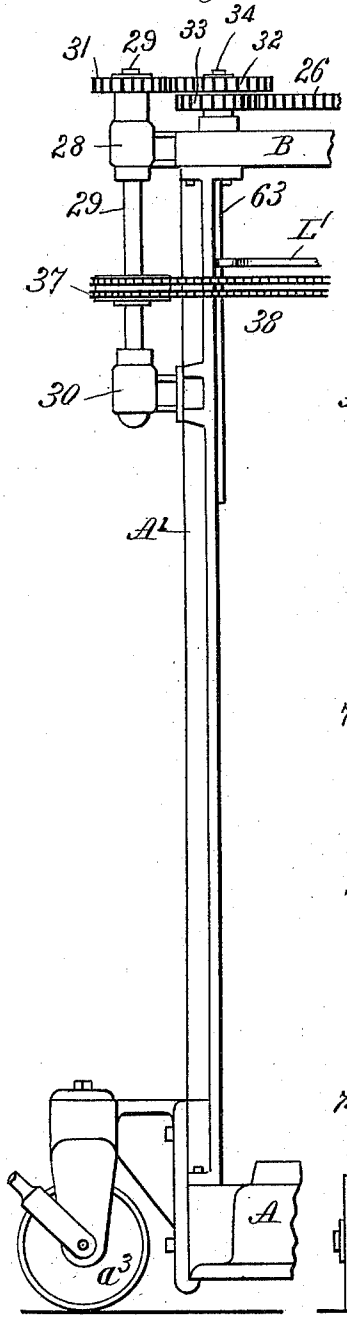

Fig. 1.

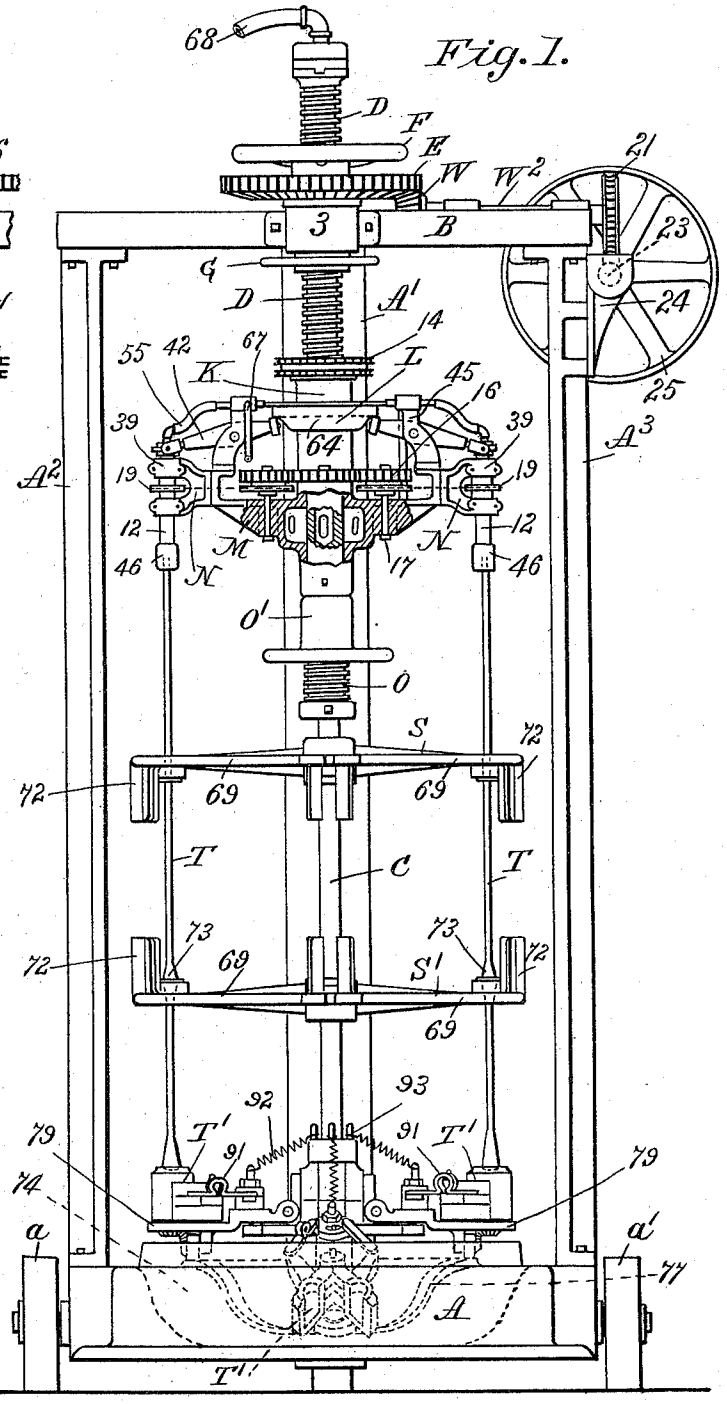

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Fig. 3.

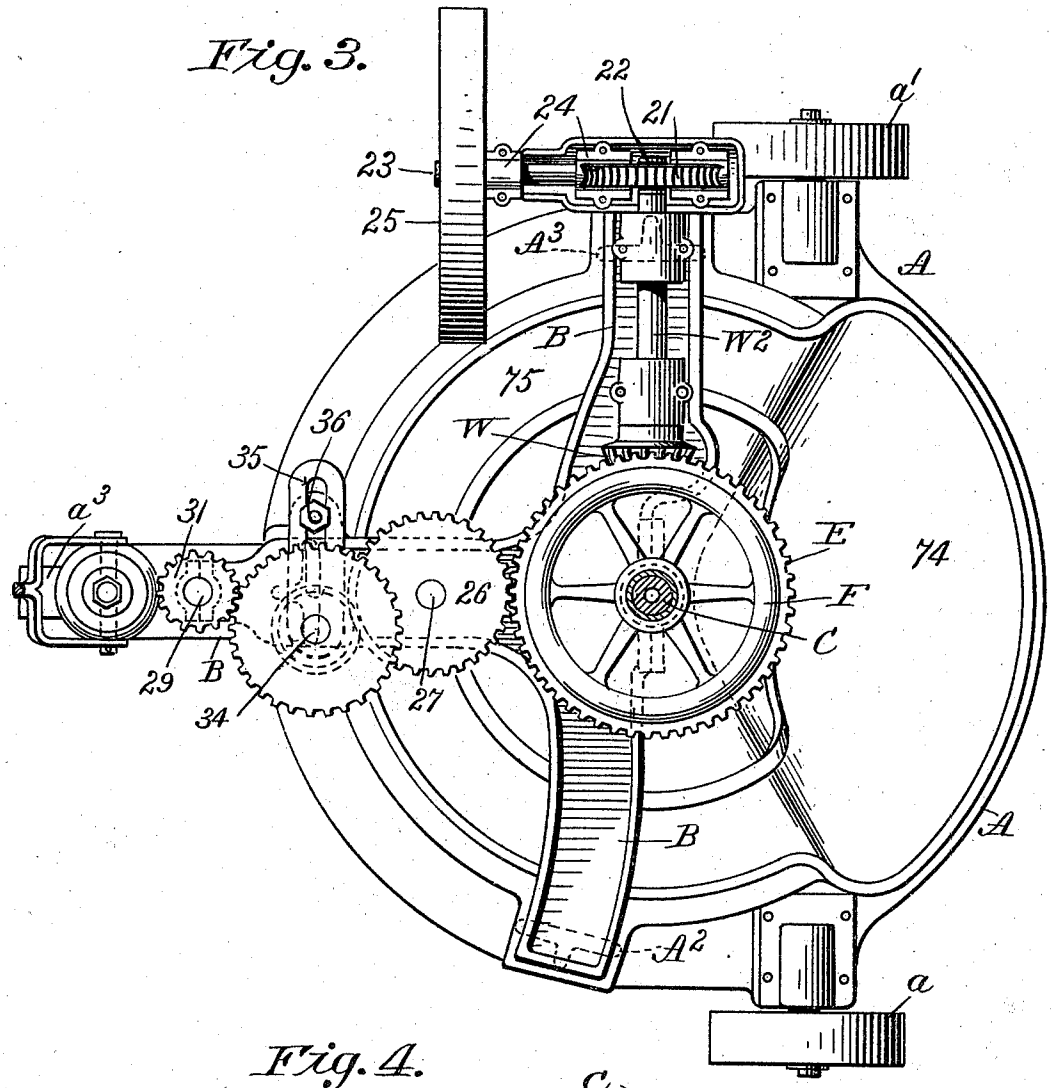
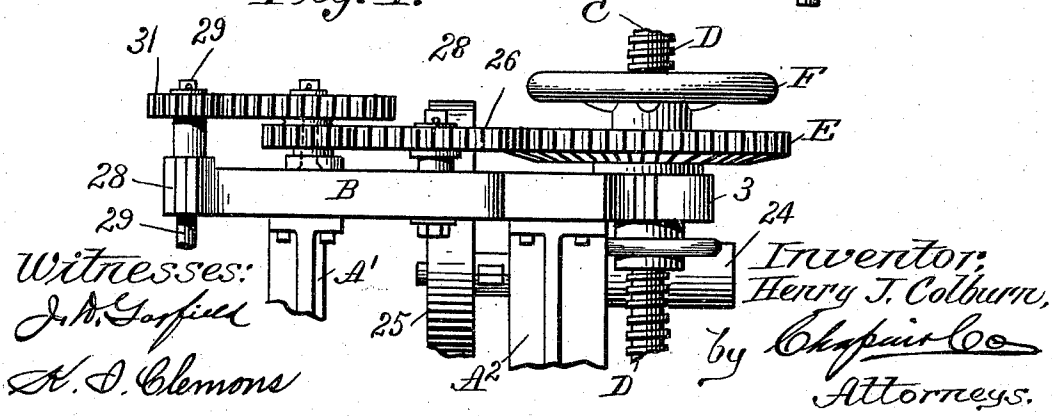


Fig. 4.



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GLASS BLOWING MACHINE.

No. 584,755. Patented June 15, 1897.

Fig. 5.

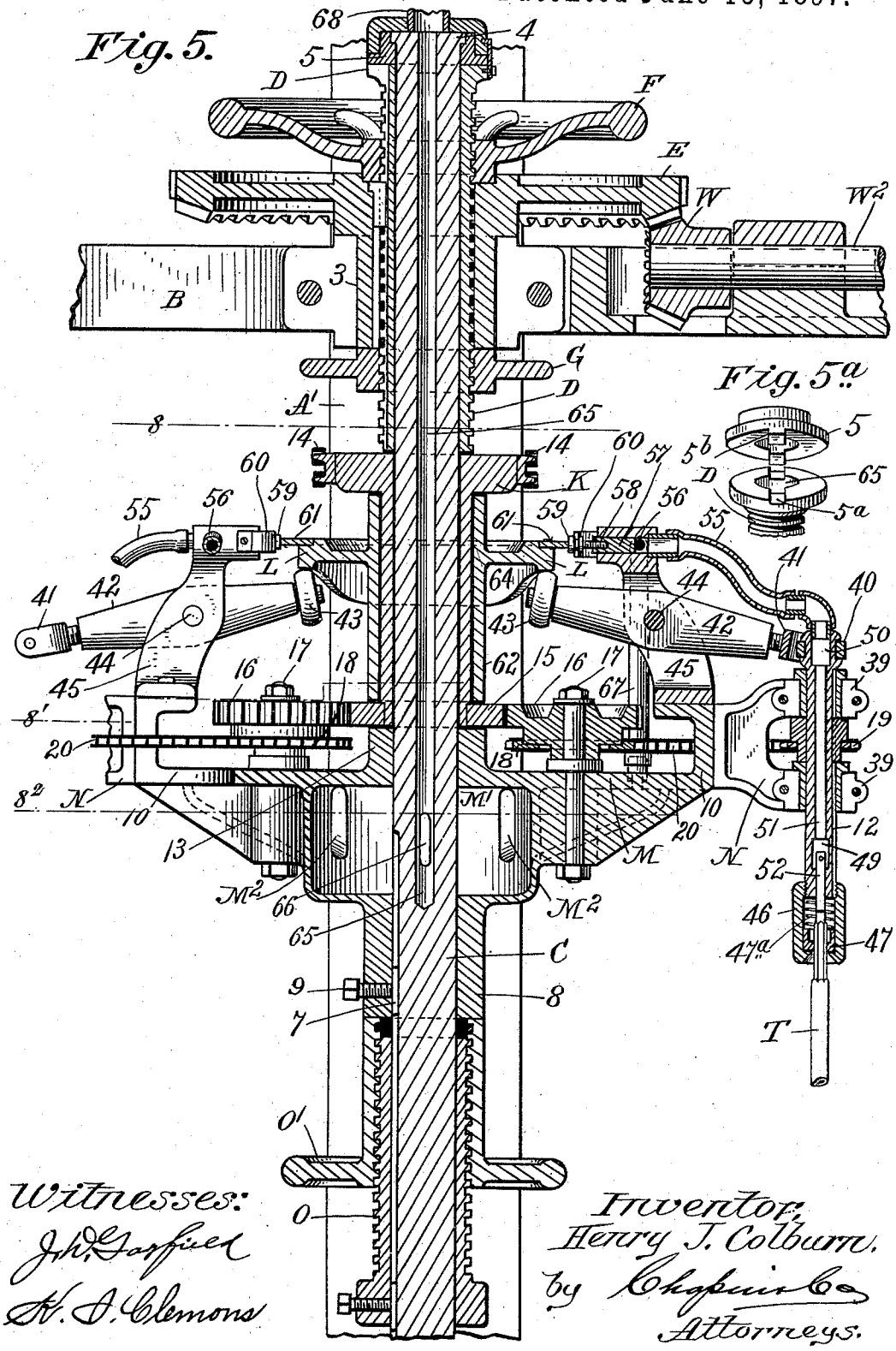

Fig. 5a.

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Fig. 6.

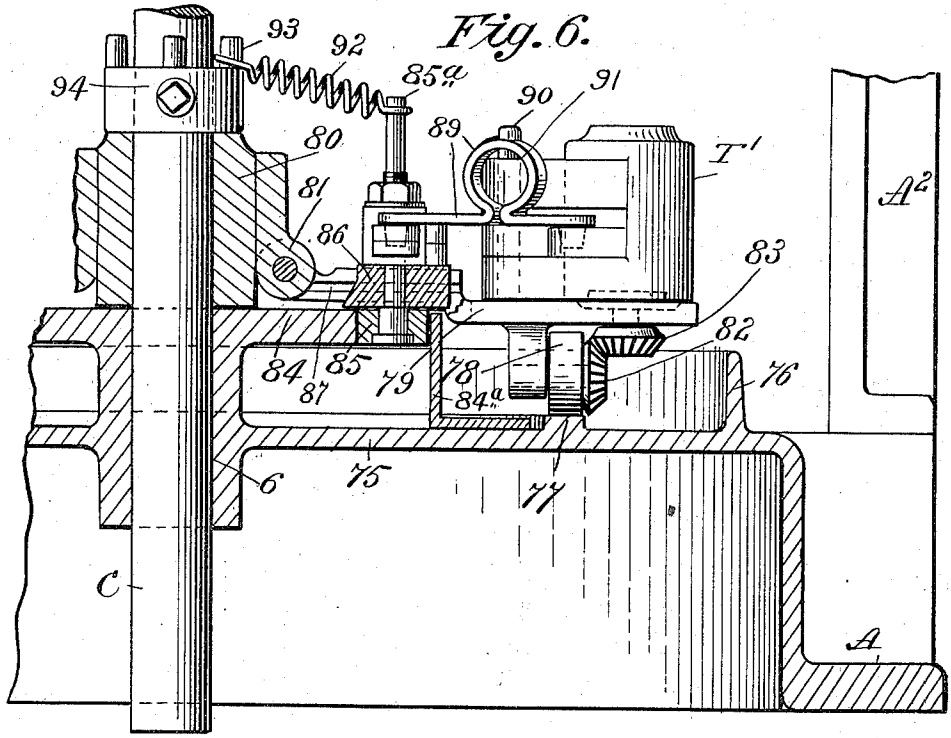
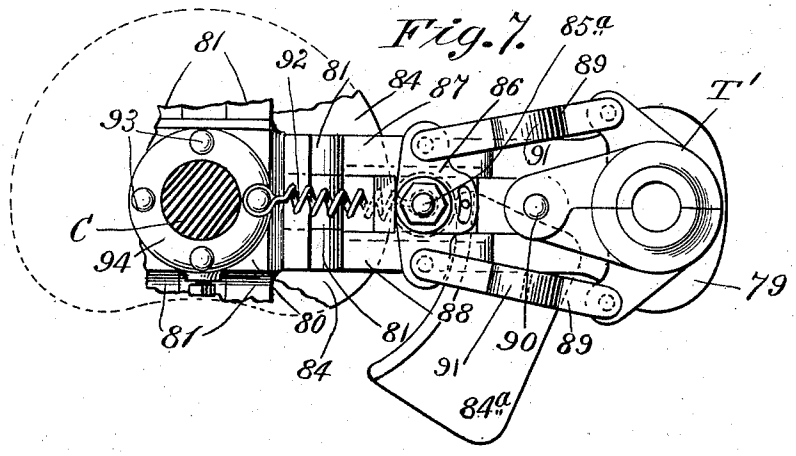


Fig. 7.



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(No Model.) 5 Sheets—Sheet 5.

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GLASS BLOWING MACHINE.

No. 584,755. Patented June 15, 1897.

Fig. 8.

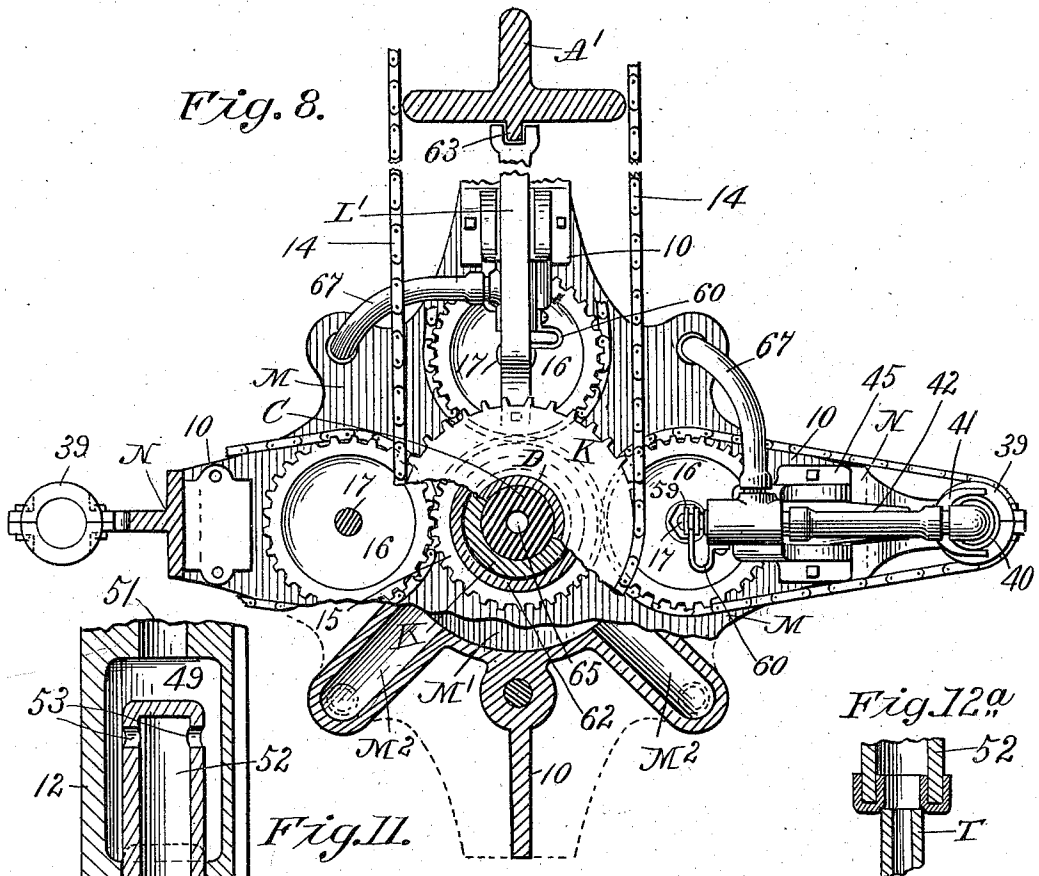


Fig. 11.

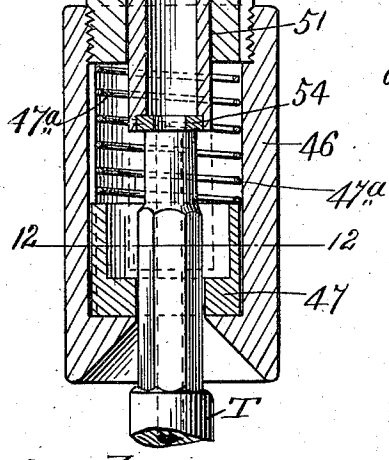


Fig. 12a.

Fig. 9.

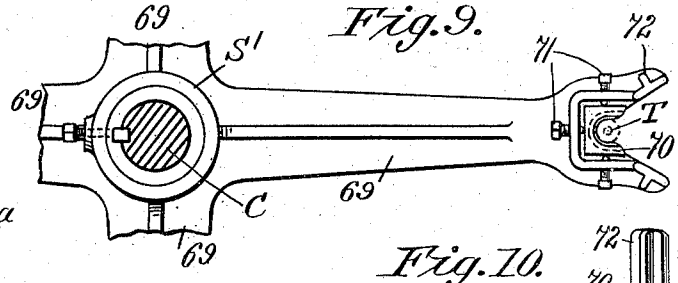


Fig. 10.

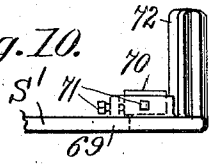
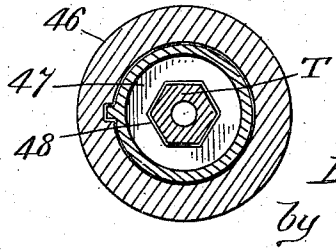


Fig. 12.



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UNITED STATES PATENT OFFICE.

HENRY J. COLBURN, OF TOLEDO, OHIO, ASSIGNOR TO THE TOLEDO GLASS COMPANY, OF SAME PLACE.

GLASS-BLOWING MACHINE.

SPECIFICATION forming part of Letters Patent No. 584,755, dated June 15, 1897.

Application filed November 30, 1896. Serial No. 613,908. (No model.)

To all whom it may concern:

Be it known that I, HENRY J. COLBURN, a citizen of the United States of America, residing at Toledo, in the county of Lucas and State of Ohio, have invented new and useful Improvements in Glass-Blowing Machines, of which the following is a specification.

This invention relates to glass-blowing machines, and has for its object the improvement in means for supporting the operative parts of the machine, whereby they are made easily adjustable vertically; improvement in means for supplying air under varying pressure to the blow-irons of said machines; improved supporting devices for said blow-irons; improved means for rotating said blow-irons at different speeds; improved construction of the sectional molds, and improved means for adjusting some of the parts supported on the main shaft, all as hereinafter fully described, and pointed out in the claims.

In the drawings forming part of this specification, Figure 1 is a front elevation, partly in section, of a glass-blowing machine constructed according to my invention. Fig. 2 is a side elevation of one of three uprights composing part of the frame of the machine, which is located back of the main shaft in Fig. 1. Fig. 3 is an enlarged plan view of the top and base of the machine with intermediate parts omitted. Fig. 4 is a side elevation of certain gear connections shown in Fig. 3. Fig. 5 is an enlarged vertical section of the upper part of the main shaft and the parts secured thereto. Fig. 5^a is a perspective view of means of engagement between the main shaft of the machine and a sleeve on said shaft. Fig. 6 is a vertical section of part of the base of the machine and showing, partly in section, a closed mold thereon. Fig. 7 is a plan view of the mold shown in Fig. 6. Fig. 8 is a sectional plan view, said sections being on the several planes indicated by the lines 8, 8′, and 8^2 on Fig. 5, the various parts being shown broken away. Fig. 9 is a plan view of an arm of one of the spiders on the main shaft which supports the blow-iron in vertical position. Fig. 10 is an elevation of the end of the arm shown in Fig. 9. Fig. 11 is a full-sized section of the end of one of the blow-irons and the socket for receiving the same. Fig. 12 is a section on line 12 12, Fig. 11. Fig. 12^a is a sectional view of one end of a valve operated by the blow-irons of the machine.

Referring to the drawings, A is the base of the machine, to which are bolted the three uprights A′ A^2 A^3, shown in Fig. 1, which is a front elevation of the machine, wherein said uprights are shown one each on the right and left hand sides of the machine and one on the back of the main shaft C. This disposition is made of these uprights in order to leave the front half of the machine entirely unobstructed. Said uprights are united at the upper extremities thereof by a three-armed top frame B, a plan view of which is shown only in Fig. 3.

Suitable truck-wheels a a' are provided and mounted on the ends of studs horizontally secured on the base A, and a swiveled truck-wheel a^3 is secured to the base A at the back of the machine and provided with a handle, only a portion of which is shown in Figs. 2 and 3, whereby said machine may be moved. As shown in said Fig. 3, that part of said top frame B which unites the uprights A^2 and A^3 passes practically over the center of the circular base A, and a bearing 3 is provided therein, which is central with said base. Said bearing receives the hub of the large beveled gear E, a shoulder being provided on the under side of said gear E for bearing against the upper surface of said bearing 3. Said beveled gear E is rotated by the engagement therewith of the beveled pinion W, secured to the shaft W^2, having a worm-gear 21 on the end thereof overhanging the top of the frame B, (see Figs. 1 and 3,) said worm-gear meshing with a worm 22 on a shaft 23, located at right angles to said shaft W^2 and supported for rotation in suitable bearings 24, bolted to the upright frame-piece A^3 near the upper extremity thereof. A suitable driving-pulley 25 is fixed on one end of said shaft 23, with which a belt engages for rotating the same. Centrally through the beveled gear E is located the main vertical shaft C, whose upper extremity is flanged, as at 4. A metal collar 5 is shrunk onto the upper end of said main shaft C, the top of said collar being flush with the top of said shaft. The pur-

pose of this collar is to afford a broad bearing for the support of said main shaft C on the upper end of a long screw-threaded sleeve D, fitted to the upper end of said shaft. The said sleeve D passes through the hub of the beveled gear E and has a free vertical movement therein, but is made to rotate with said gear as follows: A keyway is provided on the inner surface of the hole in the hub of the beveled gear E and the outer surface of the threaded sleeve D, and a key fitting tightly in the groove in the gear E and loosely in the groove in the sleeve D permits the vertical movement of the latter through said hub; but the two parts C and D rotate as one.

A positive engagement between the collar 5 on the end of the main shaft C and the upper end of the screw-threaded sleeve D, whereby said main shaft C is made to rotate with said sleeve D, is effected as follows: A slot 5^a, rectangular in cross-section, is cut diametrically across the top of the sleeve D, and on the bottom of the collar 5 rectangular projections 5^b fit into said slots 5^a, thereby positively locking the said parts together for the purpose described. Fig. 5^a of the drawings illustrates this construction. Said threaded sleeve D has a screw engagement with a suitably-threaded hand-wheel F, the hub of which has a bearing on the upper surface of the gear E, and below said bearing in the top frame B is a locking-wheel or check-nut G, which screws up to a bearing against the lower end of the hub of the beveled gear E. From the above description it will be seen that the sleeve D may be securely locked by the wheels F and G to the hub of the beveled gear E in any desired vertical position relative to said gear, and the rotation of the latter rotates the main shaft C and the parts secured thereto.

A main head M is keyed to the shaft C at 7, and a screw-threaded sleeve O is keyed to the said shaft below said main head in proximity thereto. A screw-threaded sleeve O', having a hand-wheel thereon, preferably integral therewith, fits over said sleeve O, and the upper end of said sleeve O' bears against the lower end of the hub 8 on said main head. This sleeve O' is the main support of said main head M. A set-screw 9 bears against the key 7, whereby said head M is caused to rotate with said shaft. The point of said set-screw enters said key more or less to prevent it from falling in the key-groove when said screw is loosened. Said sleeve O' is for the purpose of vertically adjusting said head M and supporting it, as above set forth.

The drawings illustrate a machine designed for four molds, and the main head M thus has four radial arms 10, (though a greater or less number may be used,) to the outer extremities of which the brackets N are secured, which brackets support the vertically-moving blow-iron spindles 12, whose lower ends positively engage with the upper ends of the blow-irons T for rotating said blow-irons and for supplying air to the molds therethrough. Said main head M has a short hub 13 projecting above the upper surface thereof, and between the end of this hub and the lower end of the sleeve D is located on the main shaft C a sprocket-wheel K, turning freely thereon. A sprocket-chain 14 on said sprocket-wheel engages a driving sprocket-wheel, to be described farther on, whereby said sprocket K is rotated independently of said main shaft C, and a gear 15, secured on the lower extremity of the long hub of sprocket K, meshes with four gears 16, supported for rotation on suitable studs 17, fixed in said head M. Said gears 16 are located centrally in line with the center line of the arms 10 of the main head M and have secured to their hubs, between said gears and the surface of said main head, the sprocket-wheels 18, engaging with which and with another sprocket-wheel 19 on the blow-iron spindle 12 is a suitable sprocket-chain 20, whereby rotary movement is imparted to said spindle and to the blow-iron engaging with the lower end thereof. The means for rotating said sprocket-wheel K, as above described, are provided as follows: The bevel-gear E is provided with gear-teeth on its periphery, as well as with beveled teeth on the under side thereof, and said first-named teeth engage with the teeth of a gear 26, supported on a stud 27 for rotation thereon, which stud is fixed in the top frame B. Said frame B has a bearing 28 in its extreme rearwardly-projecting arm for a vertical shaft 29, (see Figs. 2, 3, and 4,) whose lower end is stepped in a bearing 30, bolted to the upright A', Fig. 2. A small gear 31 is secured to the top of said shaft 29. The center of said gear and the center of gear 26 are located on the same line radially from the center of the main shaft C, and between said gears 31 and 26 are two gears 32 and 33, of different diameters, secured to a sleeve which is rotatably supported on a stud 34, fixed in the end of a yoke 35, the smaller of said gears 33 meshing with the gear 26 and the larger gear 32 meshing with the small gear 31 on said shaft 29. Said yoke is adjustable horizontally on the top frame B, a slot in said yoke having passed therethrough a bolt 36, which enters a suitably-threaded hole in the top frame B, whereby said yoke may be secured in any desired position on said frame.

To change the speed of the shaft 29, the two gears 32 and 33 are removed and two gears of different diameters substituted therefor, said bolt 36 being loosened and the yoke 35 being adjusted to bring the said new gears into mesh with the said gears 31 and 26. The length and position of said shaft 29 are such that a sprocket-wheel 37, fixed thereon, as shown in Fig. 2, will lie in the same horizontal plane as the sprocket-wheel K on the main shaft C, and a suitable sprocket-chain 14 is provided for the engagement of said two sprocket-wheels, whereby the rotary movements of the shaft 29 are imparted to said

sprocket K and through the gear and sprocket-chain connections above described to the blow-iron spindles 12 and blow-irons T, which engage by one end with said spindles.

From the preceding description it is seen that while the main shaft C is rotating at one speed the speed of rotation of the blow-irons may be varied to suit the requirements of the different kinds of work which can be performed by this machine.

At the extremities of the arms 10 of the main head M are secured the brackets N, which support the blow-iron spindles 12. Said brackets, as shown, are provided with two arms, in which are located the bearings 39 for said spindles 12, and between said bearings on said spindle the sprocket-wheels 19 are located. Said sprocket-wheels and spindles have a spline-and-groove engagement, whereby said spindles may have a vertical movement through the said sprockets and be rotated thereby.

The upper extremities of the spindles 12 are somewhat enlarged, and a groove is turned therein at right angles to the axis of the spindle, and a collar 40, engaging said groove, has oppositely-located trunnions thereon, which engage pivotally with the forked end 41 of the cam-actuated levers 42. Said levers on their inner ends are provided with cam-rolls 43 and are supported for a swinging movement in a vertical plane on pins 44, passing therethrough and through a suitable standard 45, bolted to the surface of the main head M. On the lower extremity of said blow-iron spindle 12 there is screwed thereon a mouthpiece 46, which is provided with a flaring entrance in the lower end thereof, as shown in Figs. 5 and 11, which last-named figure shows the construction of the lower end of the spindle 12 and the upper end of the blow-iron T in engagement therewith and in engagement with the piston-valve inside of said spindle. Fig. 12 shows in cross-section the means of engagement between said blow-iron and the mouthpiece of said spindle, whereby said blow-iron is positively rotated, which construction consists in providing a cup-shaped piece 47, fitting the interior of said mouthpiece 46 and having a spline-and-groove engagement with the interior thereof and a hexagonal or other angularly-shaped opening 48 centrally therethrough in line with the axis of said spindle 12, the ends of the blow-iron being made to conform in cross-section to the contour of said opening 48 and fitting loosely therein. Upon the insertion of the blow-iron into the spindle 12, if the angular sides of the end thereof do not coincide with the angular opening in the cup-shaped piece 47, the latter will be lifted against the spring 47ª, which spring will force said cup down in engagement with said blow-iron as by the revolution of the latter the angular sides of said opening coincide with the angular end of said blow-iron.

The blow-iron spindle 12, as shown in Fig. 5, is provided with a cavity 49 within it near its lower end and in the upper end thereof with a hole 50 for receiving a suitable pipe connection, said two openings being united by an air-passage 51, extending lengthwise from the lower end of said spindle into the hole 50 in the top thereof. This passage provides means for conducting air to the blow-iron and thence to the molds T′ of the machine, and said passage is controlled by a piston-valve located in the lower end of said spindle 12, which valve is opened by the contact of the upper end of the blow-iron when inserted into the mouthpiece 46 and is closed by the air-pressure above it when said blow-iron is taken away. Said valve consists of a tubular piece 52, the upper end of which is closed and which fits the bore of the air-passage 51 in the lower end of said spindle with sufficient freedom to slide freely therein. The length of said valve is such that when the blow-iron T is removed and the air-pressure has forced said valve downward, so that its lower end rests on the inner surface of the cup 47, the air-ports 53 in the walls of said piston-valve 52 near its closed end will be entirely covered by the inner surface of the passage-way 51 in the spindle 12, thus preventing the passing of the air therethrough. The dotted position of said valve when closed is shown in Fig. 11. Within the lower end of said valve is a washer 54, made of rubber, leather, or other suitable material, against which the end of the blow-iron comes in contact when it is put into the mouthpiece of the spindle. This serves not only to prevent the escape of air around the end of the blow-iron, but also prevents the battering up of the end of the valve by the end of the blow-irons, which in operating this machine have to be removed and replaced very quickly. Instead of the washer 54 the end of said tubular valve 52 may be provided with an annular rubber shoe, as shown in section in Fig. 12ª.

The blow-iron spindle 12 is connected by suitable metal pipe-fittings and a flexible pipe 55 with a valve-controlled air-passage 56, horizontally located in the top of the standard 45. A piston-valve 57 has a movement in said passage for opening and closing an air-port therein. Said valve has a screw-threaded stem 58, on the outer extremity of which is a head 59, provided with an annular groove engaging with the forked end of a bow-spring 60, secured to the upper end of said standard 45. Said valve 57 is moved to close the air-port above referred to by the engagement of the said head 59 on the end of the valve-stem 58 with a horizontally-located stationary cam-surface 61, against the edge of which the said head 59 is constantly held in engagement as said parts are carried around in a circular path by the rotation of the main head M. By varying the peripheral contour of said cam-surface 61 any desired action of the valves 57 may be obtained. Said cam-surface is held stationary by being

secured in any suitable manner to the top of the annular blow-iron cam L, cast integral with a long hub 62, which extends from the under side of the sprocket-wheel K to the top of said gear 15 on the main shaft, the hub of said sprocket-wheel turning freely within said hub 62. An arm L′ (shown partially in Fig. 2 and more fully in Fig. 8) is bolted to the top of said blow-iron cam L and extends backward nearly to the inner face of the frame-upright A′, which is provided with a vertical rib 63, with which the fork end of said arm L′ engages and whereby the blow-iron cam L is prevented from rotating by contact with the rotating hub of the sprocket-wheel K. Said blow-iron cam L is made with a downwardly-projecting cam-surface 64, (shown in Figs. 1 and 5,) with which the cam-rolls 43 on the ends of levers 42 engage and whereby said levers are operated to move said spindles 12 vertically in their bearings when during the operation of the machine the blow-irons arrive at that point in their rotation about the main shaft where they must be removed from the machine and a new blow-iron with a fresh gathering of glass substituted therefor.

Air is supplied to the various blow-irons of the machine as follows: An air-passage 65 is made in the main shaft C from the top thereof downward and terminating at a point somewhat below the surface of the main head M. A cross-passage 66 is made through the walls of the shaft C at such a point as will bring said cross-passage within the air-reservoir M′ within said main head. Said air-reservoir is practically circular in form and concentric with the main shaft C. Air-conduits M^2 are provided extending from said reservoir M′ to the surface of the main head M. Said air-conduits being in the form of hollow ribs are preferably cast integral with the walls of said reservoir and the horizontal surface of said main head, whereby they not only serve their purpose of air-conduits, but also form strengthening-ribs for the stiffening of the horizontal portion of said main head on which the various operative parts of the machine heretofore described are located. The location of these ribs or air-conduits M^2 is clearly shown in Fig. 8, wherein it is seen that their extremities lie substantially midway between the arms 10 of said main head. An opening is made down through the surface of the main head into each of these air-conduits M^2, as shown in said Fig. 8, and a flexible connection 67, extending from said opening to a suitable nipple on the side of the valved air-passage 56 in the top of the standard 45, serves to convey air from the said main reservoir to said valved air-passage.

To the upper end of the shaft C a connection is provided with any convenient source of air-supply, a short end 68 of said flexible connection being shown in Fig. 5.

Two spiders S and S′ are secured to the main shaft C (see Fig. 1) and each of these spiders is provided with as many arms 69 as there are sets of molds. In the machine forming the subject of this invention only four molds are employed. The center of the sockets in the ends of the arms 69 of said spiders and the blow-iron spindles in the ends of the arms 10 in the main head and the center of the molds T′, supported on the base of the machine, are all in vertical alinement.

In order to provide for the easy and rapid adjustment of the blow-irons in absolute alinement with the blow-iron spindle 12 and the mold T′, the sockets 70 in the ends of the arm 69 for receiving said blow-iron are made laterally adjustable, as shown in the detailed view in Figs. 9 and 10, said sockets having exteriorly a rectangular form and being inserted in a flanged rectangular opening in the ends of said arm 69, with adjusting-screws 71 passing through said flange and engaging the edges of said sockets. Furthermore, owing to the rapidity with which said blow-iron is taken from and replaced in the machine it has been found convenient to cast on the ends of the arm 69 guides 72 for said blow-iron, which flare outwardly, thereby rendering it unnecessary for the workman to be especially careful in replacing a blow-iron in the machine. Said guides on the upper blow-irons S hang downward and on the lower blow-iron stand vertically. The usual enlargement 73 on the blow-iron is provided for supporting said blow-iron on one of said spiders. In the drawings said enlargement is shown as engaging the arms of the spider S′.

In manufacturing articles of glass on machines of this description the use of sectional paste-molds is almost invariably required, and to provide for the dipping of said molds in water, for the purpose of wetting the paste lining and cooling the parts of said mold, a water-trough 74 is provided in the front part of the base A. (See Fig. 3.) Said trough is made integral with said base. Figs. 6 and 7 show the construction of one of said paste-molds (indicated by T′) and its adaptation to the machine.

Referring to Figs. 3 and 6, a base A is shown having a horizontal platform 75, occupying, as shown in Fig. 3, about two-thirds of the area of said base, the other third being represented by the water-trough 74. A raised combing 76 surrounds this platform and forms the front of the water-trough. A track 77 at a suitable distance from the center of the base and concentric therewith, where it lies on the horizontal portion of the platform, is provided for a supporting-wheel 78 to run on, which wheel is pivotally supported in proper relation to said track on the under side of a mold-carrier 79. Said mold-carrier is hinged to a hub 80, with short arms 81 cast thereon for the reception between them of the end thereof. A suitable pin passes through said arms and the end of said mold-carrier, whereby the latter may have a swinging motion in a vertical plane, which permits said mold-carrier and mold to

follow the downwardly-curved track 77 into the water-trough 74. The hub 80 is fixed upon the main shaft C in any convenient manner and rotates therewith. The movement of said mold-carriers on the track around the circular base A causes the rotation of the wheel 78 on its axis. Said wheel has secured to its face a beveled gear 82, engaging with another beveled gear 83, supported in the mold-carrier 79. A stud passes through said mold-carriers, to which stud said beveled gear 83 is fixed, which stud is central with the mold T′, a disk being fixed to the inner end of said stud, thus forming a bottom for said mold, which, being constantly rotated by the movement of the mold-supporting wheel 78, geared thereto, as described, serves to give a smooth finish to the bottom surface of any article of glass made in said mold. Said mold is automatically opened and closed at the proper time to permit it to descend into the water-trough in an opened position, and said opening is effected by the spring 92, secured by one end to the pin 93 and by its opposite end to the stud 85^a in the block 86, which spring draws the said block toward the main shaft as the mold begins its descent into the water-trough, the edge of the cam 84 being of such contour as to permit said movement of said block. When said mold is closed, the tension of said spring 92 serves to keep said roll 85 in contact with the edge of the cam 84. The closing of said mold is effected by the cam 84, against which the cam-roll 85 bears, which cam-roll is supported in the block 86, which slides between the two arms 87 and 88 of said mold-carrier, two connecting rods or arms 89 being attached to each side of said block and to one side of said paste-mold, each side of the center thereof. The two halves of the said mold T′ are pivoted at 90 to the mold-carrier, and it is readily seen by reference to Fig. 7 that any movement of the block 86 outwardly from the main shaft between the arms 87 and 88 of the mold-carrier will close said mold T′, and said movement is provided for at the proper time by the contour of said cam 84. The final closing of said mold-section is made positive by a cam 84^a, secured to the platform 75 of the base A, with which cam the cam-roll 85 engages. To positively insure the opening of said mold, the cam 84^a is provided as an aid to said springs 92, which cam is secured to the platform 75 of the base A in position to engage said cam-roll 85 and impart a quick movement of the block 86 inward toward the main shaft C. Heretofore in molds constructed in a manner similar to this said molds have been badly strained or broken by reason of more or less molten glass being sometimes caught between the sides thereof as the mold is closing over the gathering of glass on the end of the blow-iron, and without any means provided for yielding to said pressure by any of the parts more or less damage will frequently occur. To obviate this objection, one or both of the arms 89 is made as shown in Figs. 6 and 7—viz., a loop 91 is formed in said arm substantially circular in form, and by referring to Fig. 6 it will be seen that the ends of said loops are somewhat separated. This loop 91 in the arm 89 is made in such a way as to have strength enough to perform its functions in opening and closing the mold, but if any glass becomes caught between those parts of the mold which should close tightly the said loop in the arm 89 permits the two horizontal portions of said arm to approach each other more or less, thus relieving the excessive pressure on the mold and preventing any damage thereto. Said arm is made of steel and properly tempered. As said mold descends into the water-trough 74 it does so against tension of the spring 92, located between the pin 90 of said mold and the pin 93, forming part of a collar 94, which is secured above the hub 80 to the main shaft C by a set-screw. Said spring 92 is for the purpose of assisting the return of the mold-carrier to a horizontal position as it emerges from the water-trough 74.

The adjustment of the main shaft C and all of the parts secured thereto is effected by first loosening the locking-wheel G, and then by manipulating the hand-wheel F the said main shaft C may be raised or lowered at will and secured in said newly-determined position by turning up the wheel G, as described. Adjustments of the main head M on said shaft C are effected without changing the position of said shaft by first loosening the set-screw 9, which holds the key 7, and then manipulating the screw-threaded sleeve O′ to raise or lower said head, as desired, securing the latter by again setting up the screw 9. This adjustment, for example, is necessary to effect the removal of cam 61, it being necessary to change this cam for different kinds of work.

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

1. In an automatic glass-blowing machine, a suitable base and upright frame thereon, a vertically-adjustable main shaft suspended from a part of said frame over said base, and means for rotating said shaft, a series of molds, blow-irons for said molds supported in operative relation thereto, a main head vertically adjustable on said shaft, said head, with said molds and blow-irons rotating with said shaft, means on said main head for positively engaging the upper extremities of said blow-irons, means for effecting a change in the speed of rotation of said blow-irons, relative to the speed of rotation of the main shaft, means for supplying air at varying pressures to said blow-irons, and means for automatically opening and closing said molds, substantially as described.

2. In an automatic glass-blowing machine, a base and an upright frame thereon, a vertically-adjustable main shaft suspended from a

part of said frame over said base, and means for rotating said shaft, a main head secured to said shaft and adjustable vertically thereon, a series of molds secured to said shaft, and blow-irons for said molds, one end of said blow-irons engaging the end of vertically-moving hollow spindles rotatably supported on said main head, levers pivotally supported on said main head for moving said spindles, a suitable air-supply for said blow-irons, valves on said main head for controlling said air-supply, and means for operating said valves and for moving said pivotally-supported levers, consisting of non-rotating cam-surfaces supported on said main head and engaging said valves and levers and movable vertically with said head, substantially as described.

3. In an automatic glass-blowing machine, a base and upright frame thereon, a main shaft suspended from said frame over said base, and means for rotating said shaft, a main head secured on said shaft and adjustable vertically thereon, a series of sectional molds, blow-irons for said molds, hollow spindles on said head for positively engaging one end of said blow-irons, and means of support on said shaft for said blow-irons, air-conduits between said hollow spindles and an air-reservoir in said head, valves in said air-conduits and pivotally-supported levers engaging said hollow spindles, which valves and levers are operated by their engagement with stationary cam-surfaces on said head, around which they are moved by the rotation of said head, combined with means for supplying air to said reservoir, substantially as described.

4. In an automatic glass-blowing machine, a base and upright frame thereon, a main shaft suspended from said frame over said base, and means for rotating said shaft, a main head secured on said shaft and adjustable vertically thereon, a series of sectional molds, blow-irons for said molds, hollow spindles on said head for positively engaging one end of said blow-irons, and means of support on said shaft for said blow-irons, air-conduits between said hollow spindles, and an air-reservoir in said head, valves in said air-conduits and pivotally-supported levers engaging said hollow spindles by one extremity and by their opposite extremities with stationary cam-surfaces on said head, around which said levers are moved by the rotation of said head, combined with means for supplying air to said reservoir, and means for rotating said blow-irons at different rates of speed independent of the speed of rotation of said main shaft, substantially as described.

5. In an automatic glass-blowing machine, a suitably-supported main shaft and means for rotating said shaft, a main head secured thereon, a series of molds secured to said shaft, blow-irons between said molds and said main head, air-conduits for conveying air to said blow-irons under varying pressures, means for opening and closing said molds, and means for supporting and for rotating said blow-irons at varying rates of speed independent of said main shaft, consisting of a spindle for engaging one end of said blow-irons, a member on said main shaft rotating freely thereon, gear and band connections between said member and said spindle for rotating the latter, an auxiliary shaft on the frame of the machine parallel with said main shaft, a band connection between said auxiliary shaft and said member on the main shaft, and interchangeable gear connections between the main shaft and auxiliary shaft whereby the latter may be rotated at varying rates of speed relative to the speed of said main shaft, substantially as described.

6. In an automatic glass-blowing machine, a suitably-supported main shaft vertically adjustable in its bearings and means for rotating said shaft, a main head vertically adjustable on said main shaft and rotating therewith, suitable molds carried around by said main shaft in a circular path, suitably-supported blow-irons, hollow spindles on said main head engaging with one end of said blow-irons, driving connections on said head for said spindles, a blow-iron-driving member on said main shaft rotatable independently thereof, and means for rotating said member at varying speeds, an air-reservoir in said main head, air-conduits therefrom to said hollow spindles, valves in said conduits for varying the supply of air passing to said spindles, means for moving said spindles vertically, and suitable air-passages in said main shaft communicating with said air-reservoir for supplying air thereto, substantially as described.

7. In a glass-blowing machine, a sectional mold therefor, and means for operating the same consisting of a mold-carrier, mold-sections pivotally secured thereon, a block having a longitudinal movement on said carrier and one or more longitudinally-yielding connecting-arms engaging with said block and the sections of said mold, and means for moving said block whereby said sections are swung from and toward each other, substantially as set forth.

8. In a glass-blowing machine, means for rotating the blow-irons thereof consisting of a rotatable hollow spindle 12, a mouthpiece 46, thereon having an opening in its lower end for the end of a blow-iron, a vertically-movable cup 47, in said mouthpiece, a spring 47^a, between the top of said cup and the lower end of said hollow spindle, an angularly-shaped opening in said cup for receiving a similarly-shaped end of a blow-iron, an air-valve in said spindle operated by said blow-iron to admit air to the latter, and means for rotating said hollow spindle, substantially as described.

9. In an automatic glass-blowing machine, means for effecting the alinement of a blow-iron with its mold consisting of a blow-iron support 69, movable sockets in the ends of

said arms for engaging said blow-iron, and means for adjusting said sockets in a plane at right angles to the axis of said blow-iron, substantially as described.

10. In a glass-blowing machine, a main shaft and means for rotating said shaft, a series of blow-irons and means on said shaft for supporting the same, combined with means for rotating said blow-irons, and for effecting a change in the speed of rotation thereof relative to the speed of rotation of said main shaft, substantially as described.

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