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(71) Applicant **Ermanno Vertova, Via Casnida 2, 24047 Treviglio, Bergamo, Italy**
(72) Inventor **Ermanno Vertova**
(74) Agents **Barker, Brettell & Duncan, 138 Hagley Road, Edgbaston, Birmingham B16 9PW**

(54) Method and machine for making glass vials

(57) Method and machine for making vials from glass tubing is disclosed in which glass tubes (22) having a closed bottom are loaded onto a rotatable plate (11), having a series of circumferentially arranged holes passing therethrough and pliers 23′ mounted thereon. The tubes 22 are then grasped by the pliers (23′), provided on a plane not coincident with the rotatable plate, and are then grasped by lower pliers (23), also provided on a horizontal plane not coincident with and mounted on a lower rotatable plate, *the tube (22) being continuously rotated on its axis by rotating elements of the pliers (23, 23′)* and rotated throughout the circumference of the machine by rotation of the suitably controlled rotatable plates. In this rotation the tube, as drawn or pulled at suitable intervals by the pliers (23, 23′), is caused to pass in front of a series of burners (17) arranged in a suitable number on the entire periphery of the machine, such burners being provided with parabolic arc flames. Each of the vial forming tubes also passes in front of a feeling and controlling station (20) for measuring and checking the formed rough-shaped pieces and if necessary causing a further correcting burner (17) to operate. After release from the pliers (23, 23′), the finished vials fall down through holes (3) provided in a base plane (2) into small boxes in a bedplate (1) of the machine. Pliers 23 are also disclosed with rollers which impart rotation to glass tubes 22.

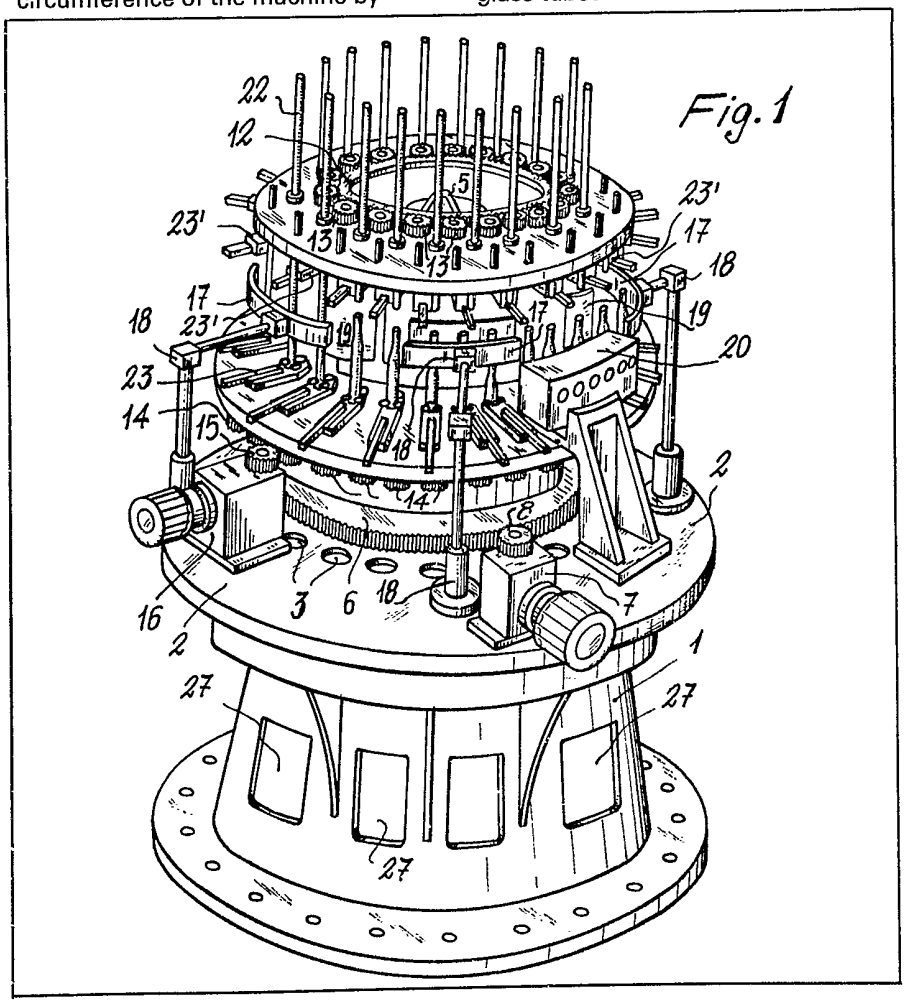

Fig. 1

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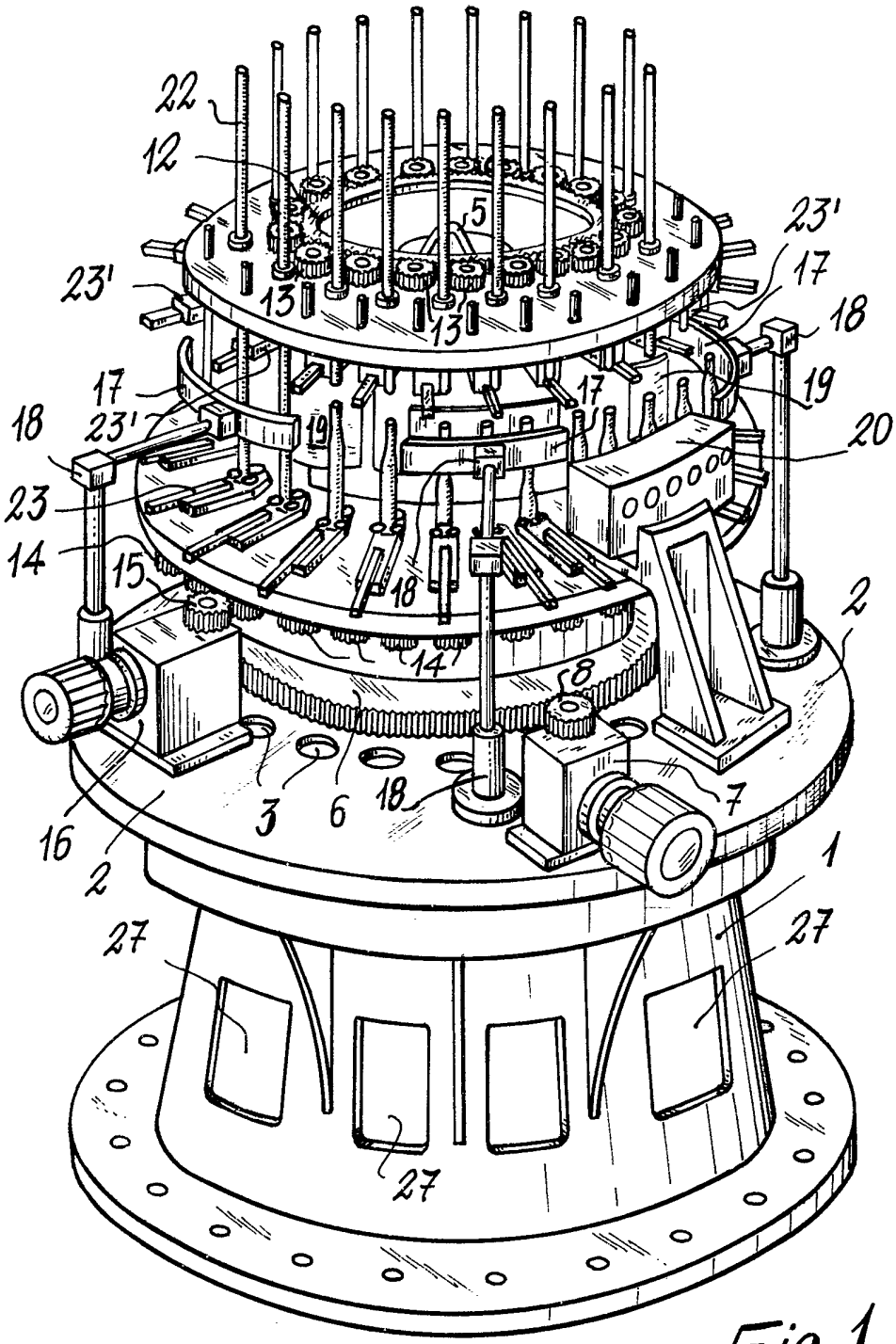

Fig. 1

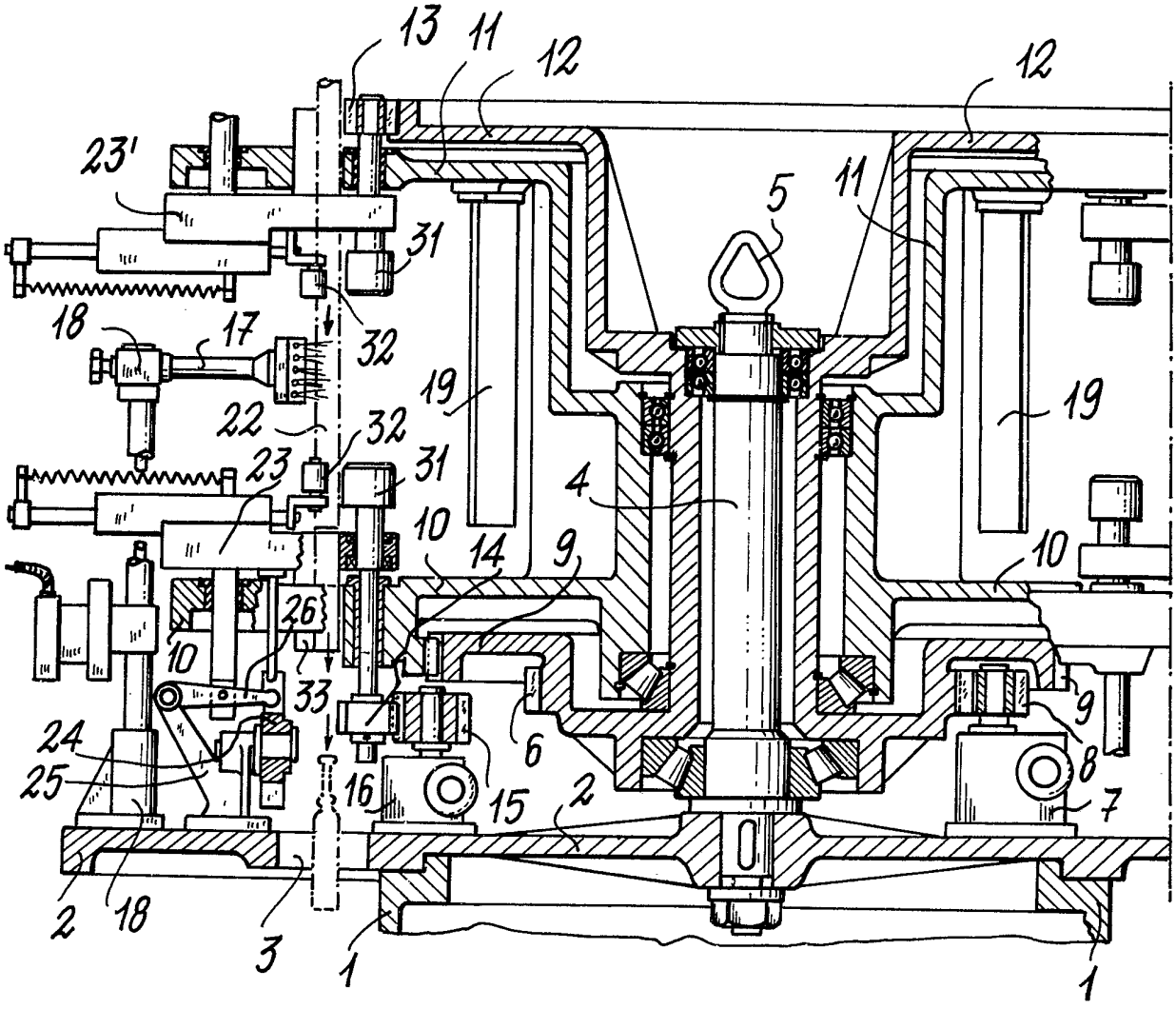
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Fig. 2

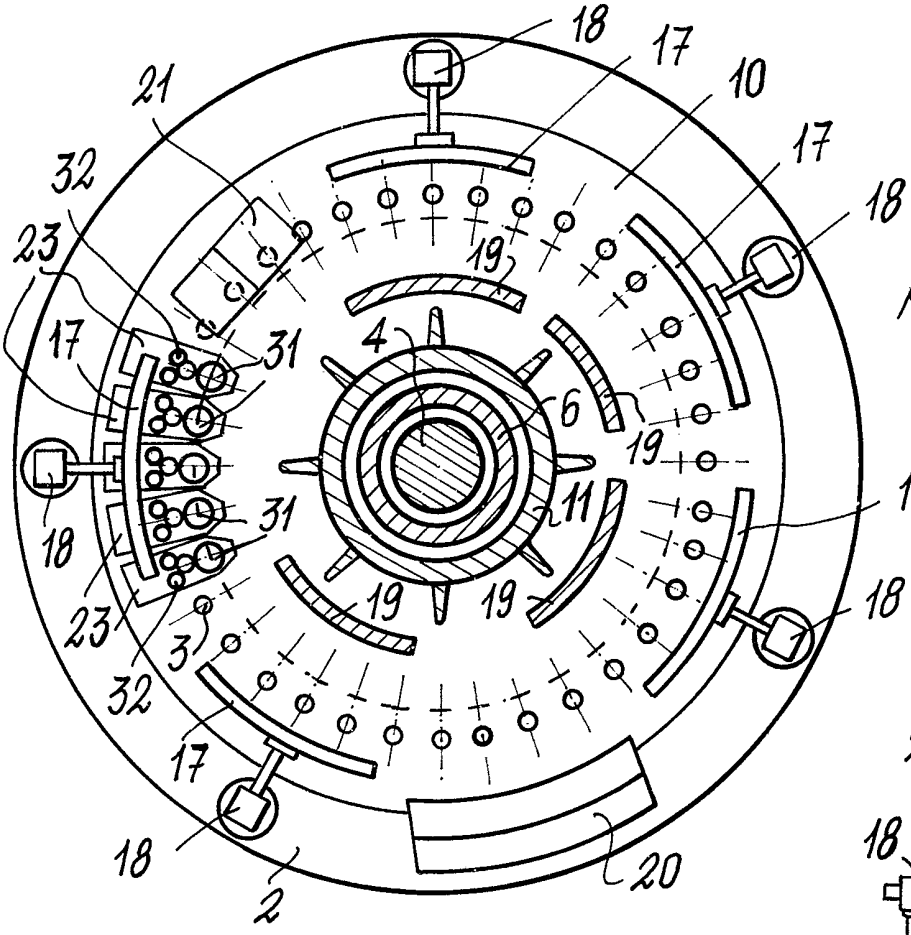

Fig. 3

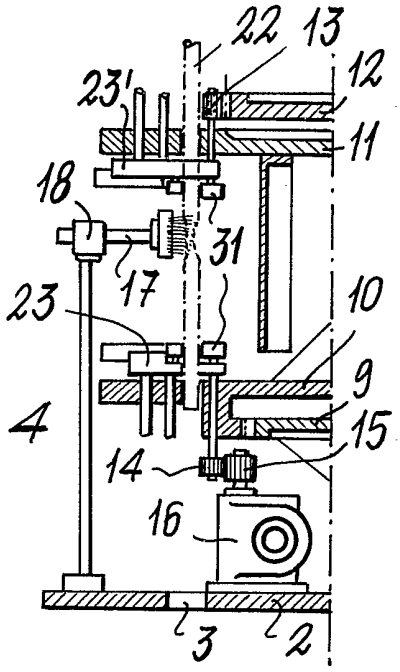

Fig. 4

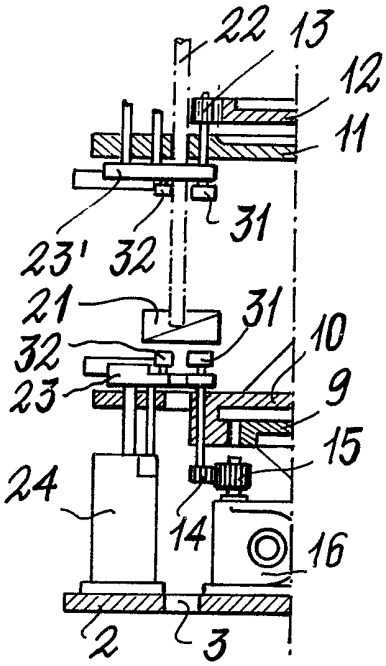

Fig. 5

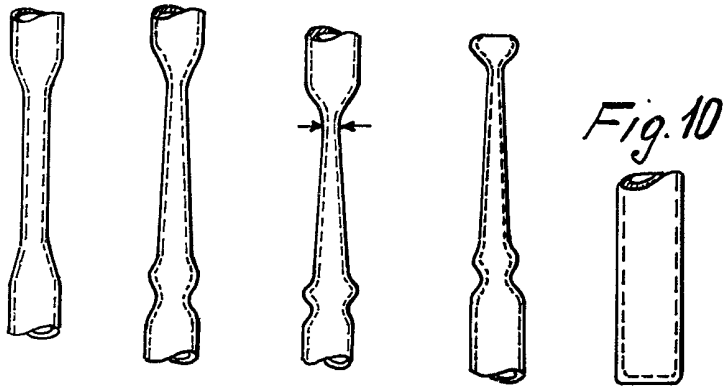

Fig.6 Fig.7 Fig.8 Fig.9 Fig.10

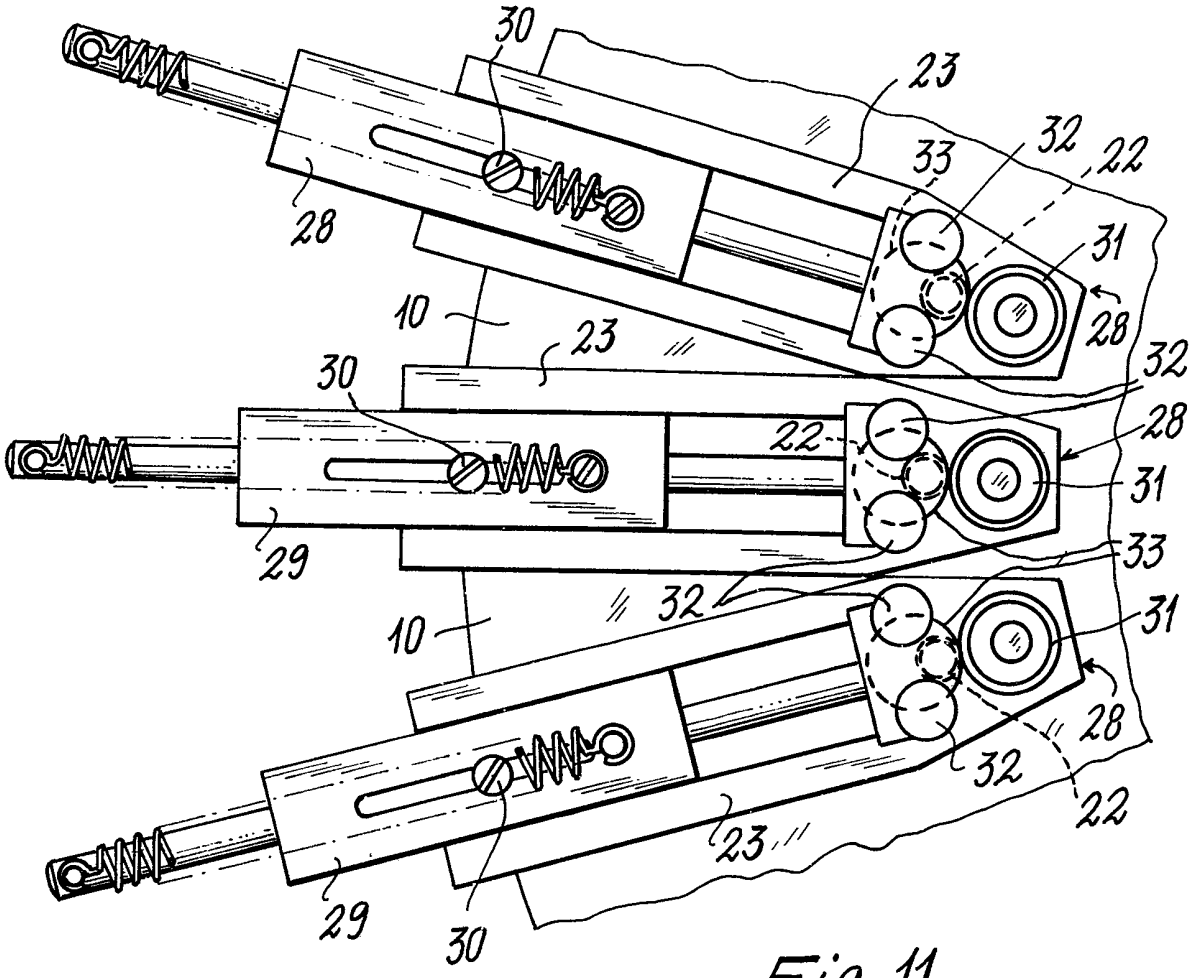
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Fig. 11

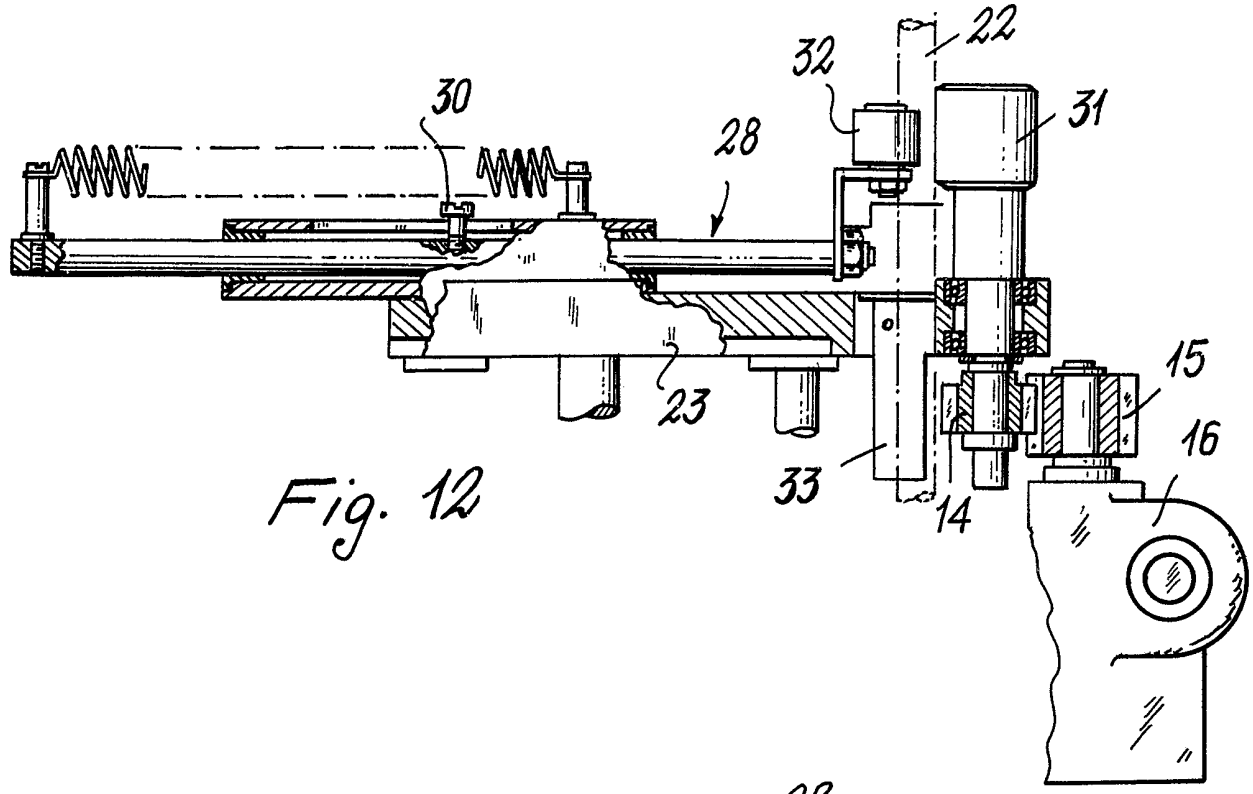

Fig. 12

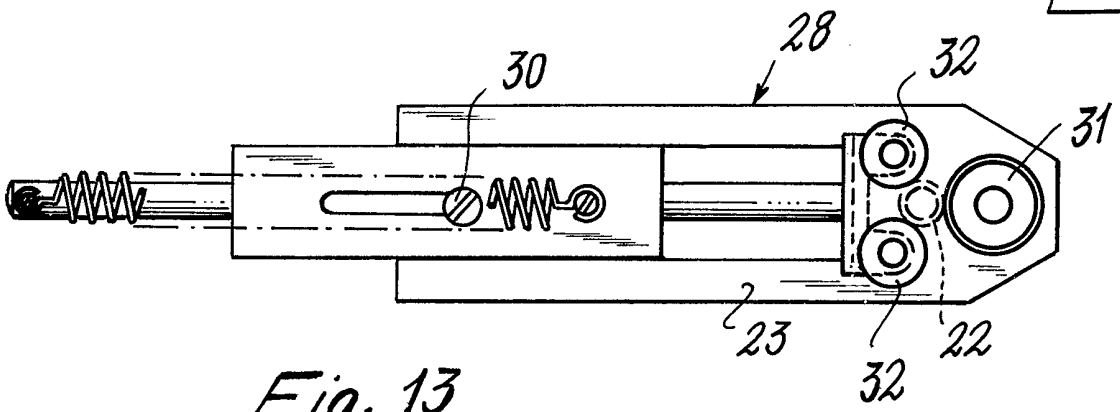

Fig. 13

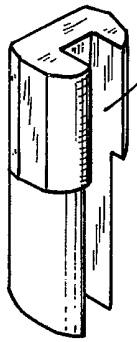

Fig. 14

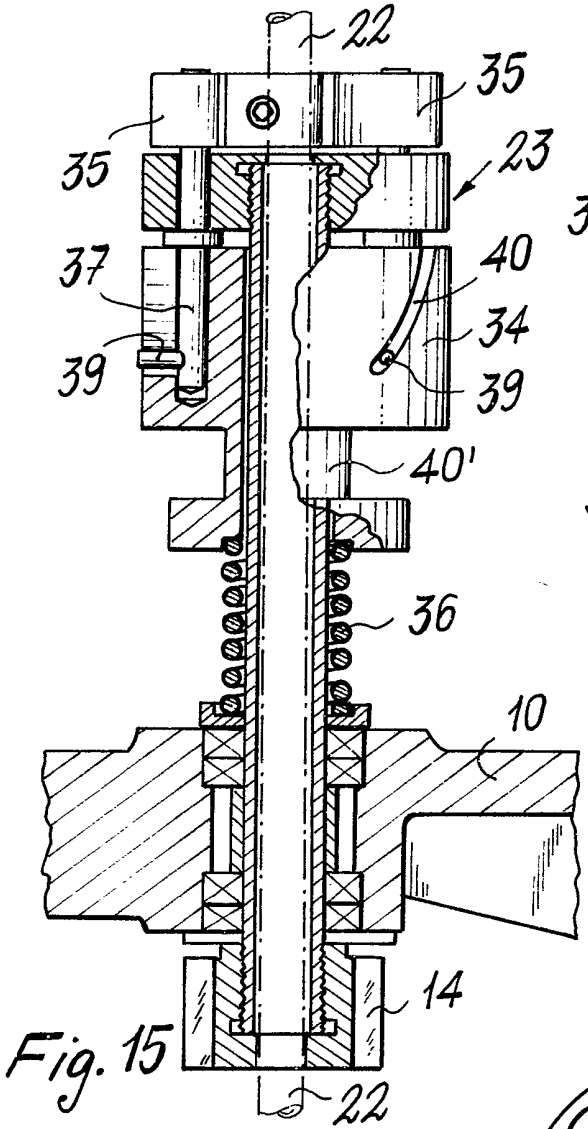

Fig. 15

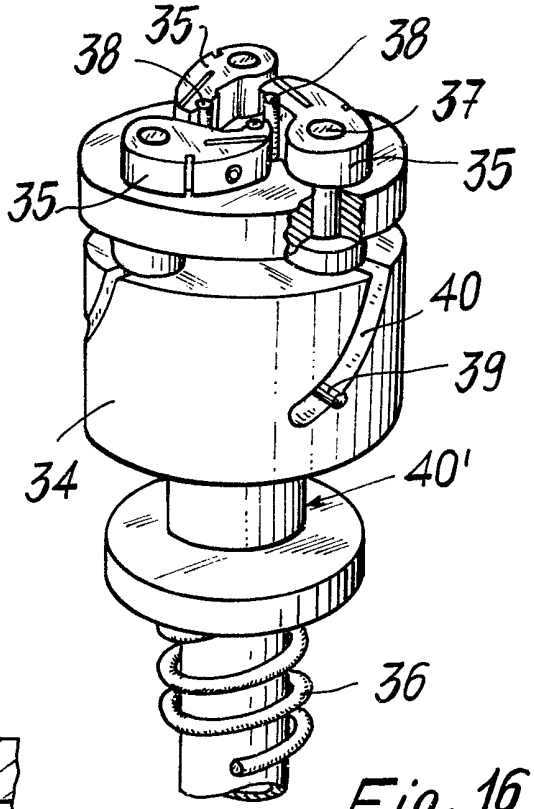

Fig. 16

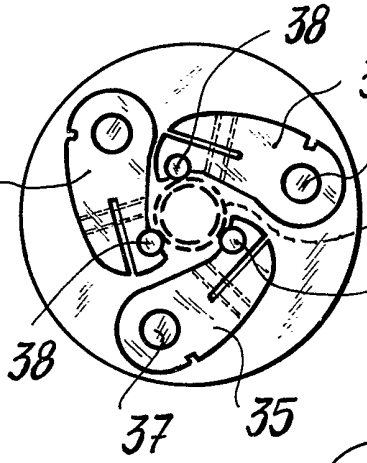

Fig. 18

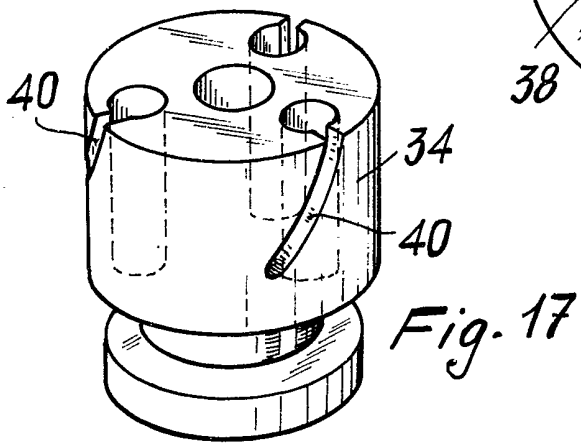

Fig. 17

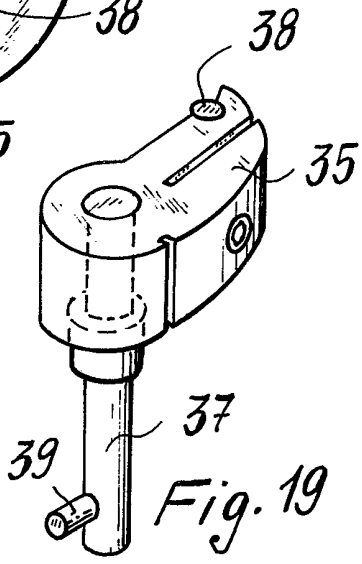

Fig. 19

SPECIFICATION

Method and machine for making glass vials

This invention relates to a method and machine for making glass vials from glass tubing, wherein rough-shaping and forming operations are continuously carried out by causing glass tube to pass in front of several stations, whilst the tube is grasped by pliers located outside a rotatable plate carrying the tube, a station of mechanical control also being provided for correction of measured faults.

As is well known, for vial production from glass tubing, glass tube is loaded onto the head of a rotating machine and then, while rotating on itself, such a tube is subjected to the action of a flame with pulls applied to the glass tube for achieving elongation and spreading of that portion which has been subjected to heat softening. Hitherto, the prior art machines provided that spindles should be arranged on a head of a rotatable machine, in turn such spindles being rotatable on themselves, at upper and lower positions. Lower portions of the spindles which are hollow are slidably mounted with respect to a vertical axis, and by the effect of gravity the tubes move through such hollow spindles to be loaded onto the machine to undergo any successive working.

In the prior art machines, the hollow spindles acting as pliers have necessarily to be of substantial dimensions, or of quite a large size. This enhances the size of all the supporting and driving members and rotating heads as well, thereby unduly enhancing the overall dimensions of the machine. Since, for obvious space considerations, too cumbersome machines cannot be provided, it follows that the prior art machines cannot be unduly enlarged, with the result that due to the reduction in the number of processing stations, also the output capacity is reduced. Additionally, such prior art machines are of poor versatility, do not allow the product quality to be controlled and corrected, that is to say to allow any faults of differences after rough-shaping operation to be corrected, with the ensuing disadvantage of not providing an even production. Thus the need arises in successive vial processing systems of providing much sophisticated and expensive equipment for distinguishing between the various types of vials of which many often have then to be discarded.

Therefore, it can be stated that the prior art machines for the production of vials from glass tube suffered from a whole series of disadvantages, such as follows:

Machines were too large and too heavy; too expensive; and pliers were too expensive or too large, or spaced apart too much from one another. These disadvantages had the effect of increasing costs, and of causing too much extended idle times, and created the need for providing additional tracking mechanisms at the stations, with resulting enormous peripheral speeds, wear, and the provision of enormous metal mass to be heated with accompanying degradation also of ambient work conditions, and further physical and social similar drawbacks.

It is the object of the present invention to provide a method and machine for simply and economically eliminating the above mentioned disadvantages and particularly increasing the hour output, and providing a high quality product in which, when working is being carried out, the rough-shaped product can be operated on so as to correct any faults or differences, so that all of the vials being obtained are within a single standard standardization range, which may be different from time to time.

To this end, the invention provides that at least one closed bottom glass tube is loaded onto a rotatable plate having a series of circumferentially arranged holes passing circumferentially therethrough, and is then grasped by upper pliers provided on a plane not coincident with the rotatable plate, and then grasped by lower pliers also provided on a horizontal plane not coincident with a lower rotatable plate, the tube being continuously rotated on its axis by rotating elements of the pliers, and rotated throughout the circumference of the machine by rotation of the suitably controlled rotatable plates. In this rotation the tube, as drawn or pulled at suitable intervals by the pliers, is caused to pass in front of a series of burners arranged in a substantial number on the entire periphery of the machine, such burners being provided with parabolic arc flames. Each of the vial forming tubes also pass in front of a feeling and controlling station for measuring and checking the formed rough-shaped piece and if necessary causing a further correction burner to be operated. After release from the pliers, the finished vials fall down through holes in a base plane into small boxes in the machine bedplate.

The invention will now be further described with reference to an unrestrictive embodiment thereof, to be considered in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic perspective view of a machine for making glass vials;

Figure 2 is a sectional view taken at the side of the rotating elements and pliers with the burners;

Figure 3 is a plan view of the machine;

Figures 4 and 5 are two partly sectional views at the zone of a burner and at the descent zone of a glass tube;

Figures 6 through 10 are views showing schematically some processing steps of the glass tube for the production of a vial;

Figures 11 through 14 are various views showing a first type of gripping pliers; and

Figures 15 through 19 are various views showing a second type of gripping pliers.

Referring now to the drawings, and particularly to Figures 1, 2 and 3, reference numeral 1 denotes the machine bedplate, in which a series of small boxes 27 for vial collection is provided. A plane 2 is provided on the bedplate 1, and hereinafter will be referred to as the "base plane", in which a series of circumferentially arranged holes 3 is

provided. Reference numeral 4 denotes a generally vertical stationary central shaft which at its upper end has a lifting eyelet 5. Reference numeral 6 denotes an externally toothed crown gear for actuating a lower inner toothed rotatable plate 10. At 11 there is shown an upper rotatable plate integral with the lower rotatable plate 10. Reference numeral 12 denotes an upper crown gear integral with the lower crown gear 6, which upper crown gear 12 performs the function of actuating a series of small pinions 13 for the control of rollers of upper gripping pliers shown at 23'. Reference numeral 14 denotes a series of small pinions for an assembly of lower gripping pliers having the reference numeral 23. The small pinions 14 are driven by a drive gear wheel 15 operated by a geared motor 16 of its own. At 17 burners are shown, in which the nozzles and accordingly the flames, are arranged on an arc of a circle or on a parabolic arc. The burners 17 are suitably supported on their supports or bearings 18 and are circumferentially arranged in a substantial number throughout the circumference of the machine. A breakfire or fireguard 19 is placed in front of each burner 17.

Reference numeral 20 denotes diagrammatically a mechanical feeling unit comprising small pins which, by projection and retraction, are capable of feeling the vial size to provide then a successive control, in this case for possible operation of a further size of correcting burner. Such a mechanical feeling unit is similar to that previously described and claimed in Italian Patent Application Serial No. 2906 A/79 in the name of the same applicant, and therefore will not be further described. However, such a unit comprises a series of projecting pins which may cause the next correction station to come into operation depending on whether the pins are spaced from, or come into contact with, the body of a vial.

Reference numeral 21 (Figure 3) shows a sprung cap on which, in its descent or downward movement, the lower end of a glass tube 22 is adjusted initially to bear before the tube is gripped by the lower pliers 23.

Now, by shortly referring to Figure 5 in conjunction with Figure 2, general reference numeral 24 of Figure 5 and elements 24, 25 and 26 of Figure 2 show a kinematic mechanism of any known construction for lifting and lowering the lower pliers 23. By a per se known operation, such a lifting and lowering movement enables the overheated glass tube to be drawn as the vial is being formed.

The forming steps are shown schematically in Figures 6 through 10.

As clearly shown in Figure 6, on passing in front of a first burner 17, a length of glass tube is overheated and by drawing it is then thinned at a zone thereof at which, in various successive steps, a neck is then formed and so on until a vial is separated from the tube whilst at the same time closing the lower end of upper tube length which then comprises the bottom of the next successive vial.

Referring now to Figures 11 through 14, the configuration will be briefly described for a first type of lower pliers 23. The upper pliers 23' are identical to the lower pliers 23 except that they are disposed in an inverted position. In the case of the lower pliers 23, the drive for the small pinions 14 is through the geared wheel 15 by its own geared motor 16, while in the case of the upper pliers 23' the drive for the small pinions 13 is taken from the Crown wheel 12 which is integral with the lower crown 6 driven through the element 8 by the geared motor 7. As it will be seen from Figures 11 through 14, each pliers comprise a pliers' body 28 carrying a sprung pusher element 29 which can be adjusted at 30. Such a pusher element 29 serves the purpose of pushing the tube 22, intended for forming the vial, against a driving roller 31, having two idle rollers 32 co-operating therewith, so that the glass tube 22 can be continuously rotated on itself. In this case, the rotation drive through the small pinions 14 is as above mentioned through the gear 15 and the geared motor 16. For the upper rollers such a rotation drive occurs through the small pinions 13 and accordingly under the action of the geared motor 7. As a result, the tube 22 is continuously rotated on itself so that, when passing in front of the flame, it will be invested at a predetermined level or height throughout its circumferential zone. In Figure 14 a grooved guide element 33 is shown which serves the purpose of keeping the tube 22 perfectly aligned vertically in pliers 23. As previously stated, the pliers 23 can be lifted and lowered, and hence can also be opened and closed, by means of the elements 24, 25 and 26.

Instead of the pliers shown in connection with Figures 11 through 14, use could also be made of pliers of the type shown in connection with Figures 15 through 19. Also such pliers are denoted as a whole at 23, thus referring to lower pliers as shown in Figure 1. Reference numeral 10 still denotes the lower rotatable plate. Reference numeral 15 still denotes the small pinion for the control of the rotation. Reference numeral 34 denotes the upper gripping head for each pliers, which is internally hollow for the passage of tube 22 and at the top carries three jaws 35 pivoted at 37 and terminating at the gripping end with a respective roller 38. The head 34 is sprung at 36. A stake 39 is provided on the pin 37 of each jaw 35 to slide in a cam groove 40' on the head 34. A lifting and lowering fork is provided for engagement in a space 40 under said head 34. As a result, the whole unit causes, through the gear 14, the glass tube 22 to rotate as gripped between the jaws 35 in the rollers 38. Upon the pin 39 sliding in the cam guide 40', the lifting and lowering fork causes opening and closure of the jaws 35, just as in the case of the type of pliers previously described in connection with Figures 11 through 14. To sum up, as to the pliers, the latter are arranged outside of the rotatable plates 10 and 11, and accordingly do not affect the machine size, but rather reduce the same. Such

pliers further allow the tube 22 to rotate on itself and can be lifted and lowered, and of course opened and closed, to be effective at suitable intervals to impart the drawing action to the tube and release the already formed vials and grip again the tube 22 being processed.

Although clearly apparent from the foregoing description and accompanying drawings the operation and operative cycle of the machine will now be briefly summarized. A closed bottom glass tube 22 is loaded on the plate 11 at a starting station corresponding to the sprung cap shown at 21. The tube gripped by a pliers 23′ is permitted to fall down onto the cap 21. Of course, such a cap is adjustable in height, and is secured to an outer, not rotatable, support. The upper pliers 23′ close, pressing the tube 22 before the cap 21 is removed from thereunder by rotation. As a result, a length of tube 22 from which the vial is to be formed, will project downwardly from the pliers 23′. On this length of tube 22 a pipe (see Figure 6) is to be formed following a desired extension of the tube. The tube length is invested by a flame sector or burner 17, while at the same time the open lower pliers 23 move upward from the bottom by means of elements 24, 25 and 26, and stop at a predetermined height of level. On closing the pliers 23 a portion of glass tube intended to form the vial body becomes captive. Now, the pipe portion is gripped by the two lower and upper pliers 23 and 23′. A sector of burner 17 invests this length of glass tube, which continuously rotates on itself as above explained, and heats the glass for a period of time required to bring it to a suitable temperature to be drawn or pulled by the pliers 23 and 23′. At the next station, a further burner 17 invests the tube portion at the join between the vial body and pipe (Figure 7) forming the so-called "vial neck", that is the shaping where the vial will then be broken without the use of a file, when the vial is to be used by the final user.

For the other stations, the pipe is allowed to cool, and is then felt in the unit 20 by a series of go not-go gauges, which will serve the purpose of enabling or not. Enabling is given for all of the dimensions which exceed a predetermined dimension, the term "enabling" being intended for triggering an enabling of gating signal for the operation of a further correcting burner. Therefore, for those pipes or vials of which the dimensions are too large, a further burner is operated for controlled narrowing of the pipe to the acceptable measure or size, which is accordingly controlled by the above mentioned mechanical feeling pin. Once this pipe correcting or standardizing operation has been effected, as outlined in Figure 8, the tube will then pass in front of so-called "cutting" burner sectors, where it will then be separated from the tubing, as schematically shown in Figures 9 and 10, or the vial is provided, while the lower end of the upper section of the tube remains closed and forms the bottom for the next vial. In effecting this vial separating operation, the lower pliers 23 are lowered by the lifting and lowering controls thereof and hold the vial captive, while the upper pliers 23′ remain engaged on the tube length 22 which is still to be processed.

At the same time, on the lower pliers 23 adjacent the just separated pipe, a further burner is effective and causes, by its action and angling, the bursting of the top portion of the vial and formation of the collar (see top portion of Figure 9), whereupon the lower pliers 23 open and allow the vial to fall synchronously down into the small boxes 27 though the holes 3. Before the new operative cycle is initiated the tube 22 which with its bottom is still in the upper pliers 23′, is invested by a further flame of a burner 17 having the purpose of "unstretching" that glass portion, thus rendering the tube, that is to say the tube bottom, quite suitable for a new cycle starting from the cap 21.

Of course, provision will be made upstream and downstream of the described machine for various devices and equipment for loading and unloading operations, hoods, etc., it being however evident that such devices and equipments are not within the scope of the present invention.

It should be also noted that these so-called correcting burners will be more than one in number, particularly in accordance with the operating speed of the machine. Particularly, it is envisaged that the correcting burner is mounted on a carriage following a semicircular path with respect to the machine centre, so that it can follow the pipe to be corrected for the time required for such a correction operation. It also derives that, although the operation has been herein described in connection with a single glass tube 22, the above described operations, also owing to the particular shape of burners 17, will simultaneously or in any case continuously occur on a plurality of successive tubes 22, thus substantially increasing the efficiency of the machine.

CLAIMS

1. A method for the production of vials from a glass tubing which adapted to be heated and pulled or drawn for separation therefrom of shaped lengths intended to form individual vials, the method comprising the continuous operating steps of loading at least one closed bottom glass tube on a rotatable plate having circumferentially arranged holes passing therethrough, and causing the tube to move down on a bearing cap, and then gripping the tube by upper and lower pliers, which are provided offset or staggered with respect to an upper rotatable plate and a lower rotatable plate, continuously rotating the tube on itself by means of rotating elements of said pliers and causing the tube to rotate on the entire circumference of the machine by rotation of said rotatable plates, causing the tube to pass in front of a series of burners of which the flames are arranged according to a circular or parabolic sector, pulling or drawing the tube to form a pipe at the flame softened zone, passing the tube in front of a further burner to form a neck at the bottom portion of said pulled or drawn pipe, cooling the

pulled or drawn tube in the machine and then causing said tube with the formed pipe to pass in front of a mechanical feeling station for feeling the pipe and, in case of undue dimensions, causing operation of a correcting burner which heats said unduly dimensioned pipe to cause the narrowing thereof, subjecting the formed zone to a burner sector to cut-off the pipe and effect separation of the vial which remains in the lower pliers, investing the vial tip with a flame to cause bursting of a closure forming the inlet of the vial, applying a further flame to the tube length remaining in the upper pliers to form a new closed bottom for a successive vial, and then opening the lower pliers to allow the formed vial to fall through a respective one of the circumferentially arranged holes and into a bottom collecting means for transportation to further working stations, and thereafter repeating the cycle with the tube length in the upper pliers.

2. A machine for forming vials from glass tubing, wherein a glass tube is rotated on itself and throughout the machine in a circumferential direction with flames operating for softening the glass and separating the individual vials from the glass tubing, the machine comprising an upper rotatable plate and a lower rotatable plate, arranged on a stationary central shaft and integral with each other, each having circumferentially arranged holes passing therethrough, a stationary base plane on a frame provided with vial collecting boxes, which stationary base plane is similarly provided with a plurality of ring-shaped holes corresponding to said holes of said rotatable plates, a series of upper gripping pliers at the upper rotatable plate and a series of lower gripping pliers at the lower rotatable plate, said gripping pliers being staggered relative to a plane defining the respective rotatable plate, a plurality of burners arranged at intervals around the circumference of the machine, in which each of said burners comprise flames provided on a circular or parabolic sector, a mechanical feeling station for controlling the dimensions of a pipe formed in the tube length by the operation of a correcting burner, control means for the rotation of said rotatable plates, and control means for the rotation of elements rotatable in said pliers in order to keep the glass tube continuously rotating on itself, mechanical means for lifting and lowering, as well as opening and closing, said pliers, and means for effecting synchronous movement of the entire machine unit.

3. A machine according to Claim 2, in which for the operation of said rotatable plates a drive unit is provided, adapted for rotating said plates by a crown gear and by a further crown gear adapted rotate a series of pinions controlling the rotatable elements of the upper pliers.

4. A machine according to Claim 2, in which for the control of the rotatable elements of the lower pliers a further operating unit is provided, which by an associated gear wheel operates a series of control pinions for the rotatable elements of the lower pliers.

5. A machine according to Claim 2, in which the lower and upper pliers comprise a drive roller and a sprung adjustable pushing element for pressing the glass tube against the drive roller, the latter co-operating with two idle rollers.

6. A machine according to Claim 2, in which each of said pliers comprise an axially sprung rotatable head with three glass tube gripping jaws internally provided with a respective roller and pivoted on a shank having a pin slidable in a cam-shaped groove.

7. A machine according to any of the preceding claims, in which at least one of said burners is mounted on a semi-circular orbit with respect to the machine centre.

8. A method of producing vial from glass tubing substantially as described herein with reference to and as illustrated in the accompanying drawings.

9. A method for forming vials from glass tubing substantially as described herein with reference to and as illustrated in the accompanying drawings.

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