

June 26, 1945.

F. J. COZZOLI

2,379,343

TUBE SEALING MACHINE

Filed June 10, 1942

4 Sheets-Sheet 2

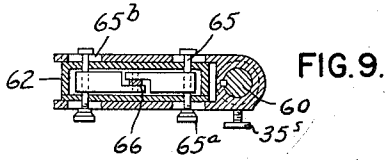


FIG. 9.

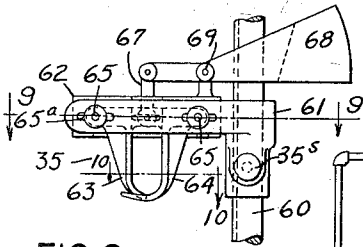


FIG. 8.



FIG. 10.

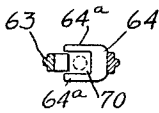


FIG. 11.

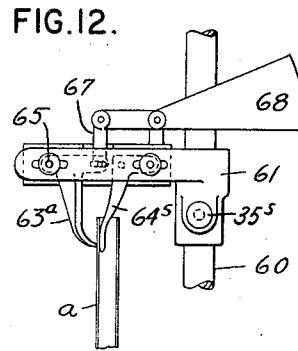


FIG. 12.

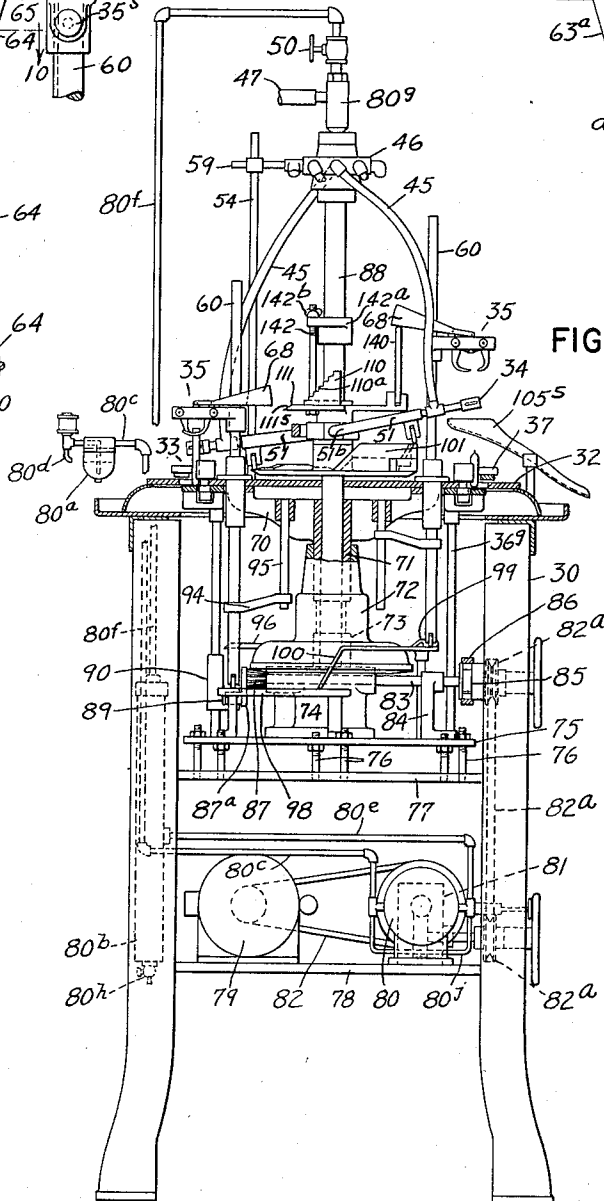


FIG. 2.

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FIG. 3.

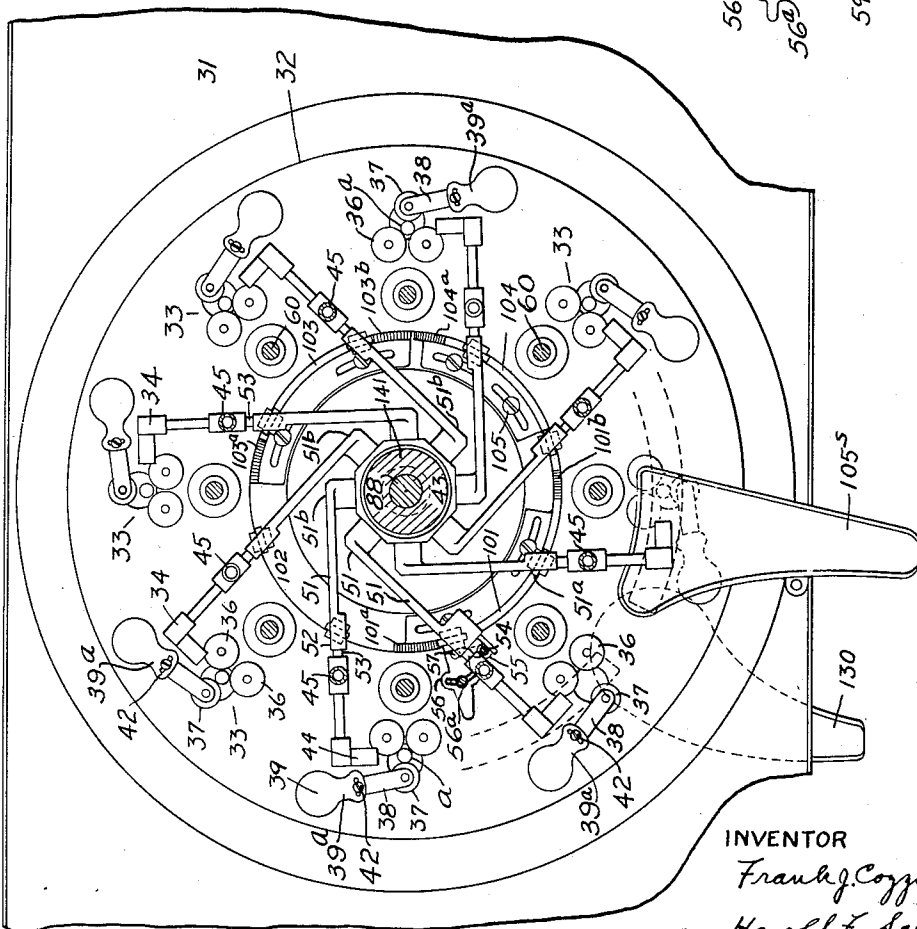


FIG. 5.

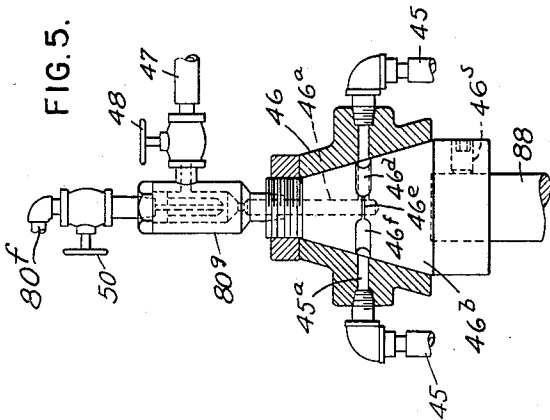
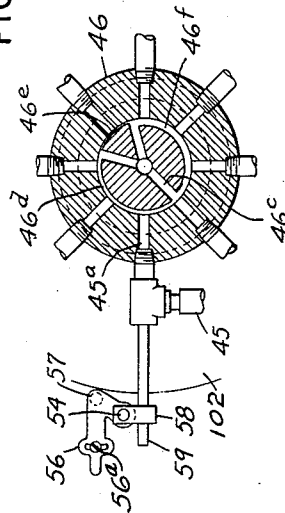


FIG. 6.



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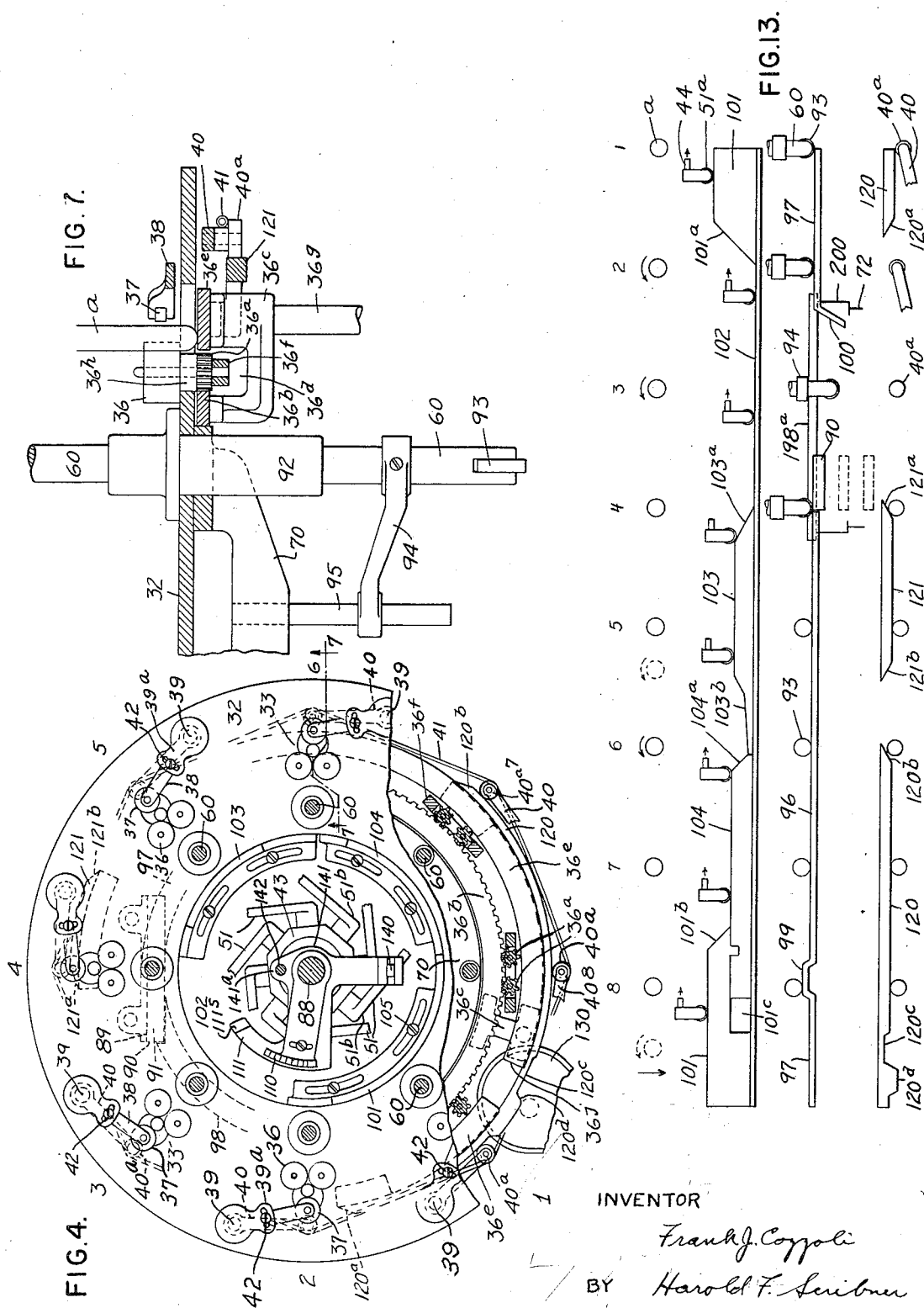
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TUBE SEALING MACHINE

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2,379,343

TUBE SEALING MACHINE

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Application June 10, 1942, Serial No. 446,523

8 Claims. (Cl. 49-7)

The present invention relates to glass working machinery and more particularly to an improved mechanism for drawing and sealing small glass tubes containing pharmaceutical preparations or accessories in the liquid or dry state. A primary aim of the invention is to render available a mechanism capable of modification and adaptation to suit various tube drawing and sealing operations on various shapes, lengths, and thicknesses of glass tubes so that a given machine may be used for sealing a variety of classes of packaged material.

A further aim of the invention is to effect a tube sealing operation in a manner providing assurance that the tubes so sealed will not, after completion of the sealing operation, contain small leaks or cracks that would render the packaged goods unfit for subsequent use or handling.

Another aim of the invention is to render available an improved tube sealing mechanism which is easily controlled and operated by a single operator and wherewith filled tubes may be drawn and sealed at a relatively high rate of speed and in which the attendant's duty comprises merely the placing of a filled unsealed tube in position before the burner, after which the cycle of heating, drawing, cut-off and sealing operations are carried on automatically and the sealed tube and the drawn off portions automatically discharged from the machine at the end of a cooling period.

Another aim of the invention is to render available a mechanically operated tube gripping mechanism which is self-adjusting in character to compensate for the slight variations in tube diameters and which is also adjustable to suit tubes of different diameters with similar compensating action to meet slight variations in such different sizes of tubes. And by way of further refinement, to render available a machine in which not only tubes of different sizes and lengths may be sealed, but in which the length or extent of drawing out of a tube of a given size may be varied to suit the drawing properties and character of the glass and wall thickness of that tube or tubes, and the nature of the seal desired, i. e., a long stemmed seal or a relatively short stemmed seal.

Still another object of the invention is to prevent tubes from bending or deforming themselves out of alignment during the heating and softening stage so that the mechanism provided for gripping and drawing the tubes can operate efficiently in a prearranged cycle and whereby the machine as a whole is caused to produce tight

seals on a run of tubes notwithstanding slight variations in tube wall thickness or diameter.

A further object of the invention is to provide an improved machine for tube sealing work which is completely self-contained and embodies all the adjuncts necessary to a glass working apparatus and which is simply constructed and assembled and capable of being repeatedly adapted to automatically effect secure seals for various types of tubes and on tubes of different sizes.

In carrying forward the objectives of this invention it is proposed to mount the entire tube sealing mechanism or mechanisms on and in a table standard of convenient height with the tube sealing mechanism per se on the top thereof where the actual operation of sealing may be watched and periodically inspected, and the drive means therefor below the table top where it is out of the way. Traveling tube receptacles are provided in the machine in which the operator successively places tubes to be sealed and each of which operates automatically to grip, rotate and release the tube in accordance with the sealing cycle determined upon beforehand. The tube receiving receptacles or chucks in the present embodiment are permanently located at a position in alignment with the associated individual burners and also in positions aligned with the individual upper tube gripping mechanisms. In other words, the upper and lower tube chucks and the burner make up a set and are permanently positioned in cooperative relation. A plurality of these sets are provided on a traveling turret and the tube rotation, heating, gripping, drawing, sealing, cooling and discharge stages or phases of the sealing operations occur successively and are carried through without any relative translation or travel of the sealing mechanisms of each set. Adjustable means preferably in the form of stationary cams are provided for actuating the burners, the size of their flames, the chuck gripping and drawing mechanisms and tube discharging means in a harmonious cycle.

At the completion of the sealing operation the lower chuck which holds the main body of the tube is automatically cleared and ready to receive the new tube, and the same applies to the upper gripping mechanism which is arranged automatically to discharge the drawn off portion of the tube into a waste chute at a convenient point in the travel.

As there is a time element involved in the heating, drawing, sealing and cooling stages, the invention proposes the combining of the multiplicity of such tube sealing mechanisms into a single

compact structure and to stagger their sealing cycles so as to utilize to maximum advantage the waiting time involved in the different stages of the sealing of any one tube. In this way the rate or number of tubes sealed per hour is the product of the number of successively operating sealing machines embodied in any one assembly. I have found that a practical and efficient machine for this purpose may combine up to about eight individual sealing units, for with this number the task of successively loading the tube receptacles does not unduly burden the attendant nor result in too large a machine structure. With due regard to the total time required for sealing the maximum weight or size tube, the successive starting of eight tubes on their sealing journey works out well for this purpose. The machine is also constructed so that each of the eight individual sealing machines are caused to move bodily at a moderate rate past or in front of the operator's station where he may receive tubes from a filling machine and place them in the continuously moving sealing machines. The entire assembly is self-contained and constructed and arranged to be driven at a moderate rate of speed which may, however, be varied to suit the speed of filling and loading and the total time necessary to seal off a given tube.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which—

Figure 1 is a front view of a sealing machine embodying the invention, in which but two of the eight sealing units are illustrated.

Fig. 2 is a side view of the sealing machine like that of Figure 1 mounted upon a slightly taller base, and with certain parts removed and other parts in section more clearly to illustrate the interior operating mechanisms. The view is taken substantially along line 2—2 of Fig. 1.

Fig. 3 is a horizontal view taken along line 3—3 of Fig. 1.

Fig. 4 is a horizontal view of the rotatable turret, the burner arms being broken away to illustrate more clearly the cam tracks and tube receptacles and a portion of the turret removed to show the mechanism therebeneath. The view is taken substantially along line 4—4 of Fig. 1.

Figs. 5 and 6 are enlarged vertical and horizontal views respectively of a fuel distributing head, taken substantially along lines 5—5 and 6—6, respectively of Fig. 1.

Fig. 7 is an enlarged vertical sectional view of one of the tube receptacles and a portion of the drawing mechanism, taken on line 7—7 of Fig. 4.

Fig. 8 is an enlarged view of one of the tube grippers.

Fig. 9 is a horizontal sectional view of the gripper taken along line 9—9 of Fig. 8.

Fig. 10 is a horizontal sectional view through the jaws of the gripper and is taken along line 10—10 of Fig. 8.

Fig. 11 is a view similar to Fig. 10, but illustrating the gripper jaws in open position.

Fig. 12 is a variant form of upper gripper which is suitable for certain kinds of tubes.

Fig. 13 is a composite diagrammatic representation of a sealing cycle which, in connection with Figs. 14 to 21, illustrates a typical sealing operation.

Figs. 14 to 21 illustrate the successive operations performed in sealing a filled tube.

Fig. 22 is a plan view of a tube receptacle and a portion of the turret and illustrates a variant form of tube rotation-stopping means.

Fig. 23 is a vertical sectional view of the tube rotation-stopping mechanism, taken substantially along line 23—23 of Fig. 22.

Fig. 24 is a fragmentary view of a preferred form of mechanism for varying the extent that a tube may be stretched.

Referring to Figures 1 and 14 to 21, the machine therein illustrated is represented as being set up for the sealing of fragile onion skin tubes filled with a liquid such as ammonia, iodine, etc. Briefly the sealing cycle for these tubes is as follows: The filled tube is placed in the open receptacle Fig. 14, then gripped, rotated and the flame applied, Fig. 15. When the glass has softened the flame is withdrawn and the tube drawn to a capillary size, Fig. 16. After a cooling interval to vent gases generated during the heating through the capillary, the flame comes on again and severs the tube at the drawn portion, Fig. 17, and then follows the needed portion downward slightly to fuse the opening shut and form a ball seal, Figs. 18 and 19. The flame may again be withdrawn away from the point of the tube to allow for tube cooling. At the same time the tube is released from the receptacle and ceases rotating to facilitate inspection after which the chuck opens and allows the tube to drop into a discharge chute through an opening in the bottom of the carrier. This method and character of sealing is but representative of the many types that may be performed with the present invention and it is to be understood that one or more of the steps outlined may be changed, varied or eliminated to suit the requirements of the various types of styles of tubes or tubular receptacles.

Referring more particularly to Fig. 2, the machine comprises a standard 30 which supports a spacious top surface 31 and a rotatable turret or table member 32. The turret 32 carries a plurality of sealing units, and the description of one will, it is believed, suffice for them all.

With reference to Fig. 3, each sealing unit comprises essentially a tube receptacle and tube rotating means, designated generally as 33, a burner 34 and an upper tube gripping means designated generally as 35 (Fig. 8). The tube-receptacle and tube rotating means 33 comprises two continuously driven rollers 36 whose adjacent outer peripheries form a V-shaped notch into which a tube *a* is placed and normally held in contact with the peripheries of the driven rollers by a third roller 37. The three rollers together form between them a pocket or receptacle which receives the tube, holds it upright, and rotates it about its longitudinal axis. The third roller 37 is carried on an adjustable lever 38 which is mounted on a pivot 39. The pivot 39 is journaled in and extends through the turret top 32 and carries at the underside of the turret top a similarly positioned lever 40 (see Fig. 4) that is normally spring pressed toward the center of rotation of the turret. The upper end of the pivot 39 is provided with a slotted plate 39^a which over-

laps the roller carrying arm 38. By means of the screw and slot connection 42 therebetween, the roller arm 38 may be swung in or out, relative to the position of the under arm 40. Normally the parts 38, 39 and 40 move as a unit during the operation of the machine. As there are eight sealing units in the embodiment illustrated, a convenient means for urging the guide rollers 37 toward the tubes and the latter toward the driving rolls 36, consists of a garter spring 41 which is passed around the outside of the free ends of each of the arms 40, and which acting through the pivot 39, plate 39^a and lever 38, urges all of the guide rollers 37 in tube gripping directions. Each of the tube receptacles above mentioned, is adjustable in size merely by adjusting one of the rollers, in this instance the roller 37, outwardly or inwardly as by means of the screw and slot connection provided between the arm 38 and the overlying portion 39^a of the pivot 39. This adjustment feature corresponds in principle to that disclosed and described in my aforesaid Patent No. 2,258,408 at 28, 29 in Fig. 3 thereof.

Each tube receptacle is provided with its own heating means, in this instance in the form of a gas burner 34 whose arm 51 extends somewhat radially of the turret and which is pivoted at its inner end at 51^b in any suitable manner, as by a screw means 57 illustrated in my prior Patent No. 2,258,408, to a rotatable block 43 that rotates with the turret. Each burner is provided with a gas jet 44 which lies circumferentially ahead of the tube receptacle and approximately the same distance radially from the center of rotation so that the flame thereof will be directed toward the axis of a rotating tube. Each burner has a flexible hose connection 45 with a rotating distributor head 46 and a fuel gas is admitted to the latter through the supply pipe 47 and valve 48. The fuel gas may, if expedience requires, be thinned with an air mixture furnished through pipe line 80¹ and valve 50.

Each of the pivoted burner arms 51 is provided at its outer end with an enlarged head 52 and receives therein a radially adjustable stem 53 of the burner. When the machine is set up for sealing a tube of a given diameter the burner 44 is adjusted radially outward relative to the arm 51 so as to bring the flame at the required place on the tube. Small tubes will require an inward movement of the burner 44, whereas, larger tubes require an outward movement.

The burners are caused to rotate with the turret and normally are maintained at a fixed distance ahead of their corresponding tube receptacles by means of a vertically disposed drive rod 54 which passes through a slot 55 formed at the end of one of the burner arms 51. The lower end of the drive rod is mounted in an adjustable bracket 56 which is pivoted at 57 to the turret top 32, so that adjustment of the bracket 56 about its pivot will cause the drive rod 54 to move circumferentially forward or backwards relative to a radial plane of the turret. (See Figs. 2, 3, 6.)

As the rod 54 extends through the slot 55 in one of the burner arms, such forward or backward movement of the rod, correspondingly repositions the flame end of the burners 44 further away from, or closer to, the axis of the tubes thereby to vary the spatial distance between the walls of the glass tubes and the burner tips. The bracket 56 is provided with an arcuate slot near its outer end through which a screw 56^a passes

and threads into the turret top 32. By loosening the screw 56^a, the bracket 56 may be swung about its pivot 57, and the drive rod 54 which is offset from the pivot 57, thereby moved ahead or to the rear of the position illustrated in Figs. 3 and 6. When the burners have been adjusted relative to the axis of the receptacles to suit a given size tube they are maintained in that position. The drive rod 54 extends upwardly and is also connected by a sliding block 58 to a bar 59 that extends outwardly from the gas distributing head 46. Through the connection just mentioned the gas distributing head is moved in synchronism with the burners 44 with which it is connected by hose connections 45.

Coaxially positioned above each tube receptacle is an upper tube gripping mechanism 35 which is adjustably secured by means of a thumb screw 35^s to a vertically movable rod 60. As illustrated more clearly in Figs. 9 to 11, each gripper mechanism comprises a bifurcated radially extending support 61 which has a keyed connection with the rod 60. The radial arms of the support extend outwardly over the tube receptacle and support therebetween a radially adjustable pivot block member 62. Each gripper has mounted therein two jaw members 63 and 64 which swing about spaced pivots 65. The two jaws face each other and have a toggle-like connection 66 at their upper ends with a vertically movable link member 67. As the link is moved down from the position shown in Fig. 8, the lower ends of the jaws are caused to open (Fig. 11) to receive a tube end. The means for opening and closing the jaws on the tube includes a weighted lever 68 which is rocked about a fixed pivot 69 carried on the radially adjustable toggle block 62. As will be seen from Figs. 8, 10 and 11, the lower end of the gripper jaw 64 is provided with two extending fingers 64^a which pass one on either side of the lower end of the coating jaw 63. The inner surfaces of the jaws define a substantially closed opening 70 into which the tube end is caused to extend prior to the time it has become heated and softened. As will be hereinafter explained, the gripper is lowered with open jaws over the end of the tube at or about the time the flame is applied to a lower portion thereof. The jaws remain open permitting the tube to rotate freely therein and at the same time give any lateral support that may be necessary to the end of the tube as a midsection thereof softens. When the heating stage has been completed the jaws close upon the end of the tube and the gripper is quickly raised to stretch out the softened portion to a relatively fine capillary size. Where the jaws of the gripper are not so formed as to box the end of the tube before gripping, there is likelihood of the tube bending or sagging and being whirled around at a right angle before it reaches the stretching station. The boxing of the end of the tube by a gripper constructed as described provides for free rotation of the tube therein, simultaneously supports the upper end of the tube against lateral forces and at the time of gripping centers the tube end coaxial with the main body of the tube so that when stretching occurs, the stretched portion will be centered and, therefore, uniform.

Fig. 12 illustrates a modified form of upper gripper in which one of the jaw members 64^s is fixed against pivoting motion and is shaped and adapted to enter the open end of a tube. The outer gripper jaw 63^a is mounted to swing about the pivot 65 and is connected to the link 67 and weight

68 in a manner similar to that previously explained in connection with Fig. 8. With a gripper of this style the stationary jaw 64^a is lowered into the open end of the tube and steadies same as the tube becomes heated and softens. At the completion of the heating stage the weight 68 is caused to drop thus bringing the movable jaw 63^a into closing position on the glass tube after which the gripper is quickly elevated to stretch out the glass at the heated area.

With both styles of grippers (Fig. 8 and Fig. 12) the toggle block member 62 is adjustable radially in the arms of the bracket 61 to suit different tube positions. Clamp nuts 65^a carried on the pivot pins 65 are provided to clamp the toggle block in position such that the lower ends of the jaw members are coaxially related with respect to the tube. Elongated slots 65^b of the bracket arms afford a range of adjustment to suit the center distances of a variety of tube sizes.

Main drive

The main support and drive means for the turret 32 comprises a main casting member 70 which has a projecting hub portion 71 keyed to and supported by bevel gear member 72. The latter is internally bored and is journaled upon a bearing 73 of a stationary bearing bracket 74. The bearing bracket 74 rests upon an adjustable shelf member 75. By adjusting the supporting screws 76 the shelf 75 may be raised or lowered slightly relative to the fixed shelf 77 thereby to position the main supporting bracket 70 and plate 32 carried thereby at the proper elevated position and in the proper horizontal plane. Under the fixed shelf 77 there is another shelf 78 which supports a main drive motor 79, an air pump 80, and a worm wheel speed reducing mechanism 81. A V-belt 82 drives the pump and speed reducing mechanism and power from the latter is delivered to the mechanism on the adjustable shelf 75 through a variable speed belt drive mechanism 82^a. The V-pulley at the upper end of the drive is mounted upon a shaft 83 which is journaled in a bracket 84 and also in the bracket 74 secured to the adjustable shelf 75. A clutch mechanism 85 operated by lever 86, is provided to connect and disconnect the drive at will.

The inner end of the drive shaft 83 carries a bevel gear element 87 and a crank element 87^a. The bevel gear 87 meshes with the bevel gear 72 whereby the latter and all the mechanisms supported thereby may be slowly turned about the central shaft 88 which normally does not rotate. The crank mechanism 87^a operates in a slot 89 provided in a gripper elevating bracket 90. An upper surface 91 of the elevating bracket forms part of an annular cam track on which the lower ends of the gripper rods 60 travel and is reciprocated vertically in timed relation with the angular movement of the gripper rods 60. Each of the rods 60 extends through a relatively long bearing 92 secured to the turret 32 and carries at its lower end a roller 93, and a laterally projecting arm 94 which slides vertically on a fixed pin 95 depending from the main supporting bracket 70. The spacing of the rods 95 and 60 provide ample leverage for maintaining the gripper rod 60 in a fixed angular position throughout its rotation about the center of the shaft 88 of the machine. Any slight wear between the arm 94 and the fixed guide 95 has little effect on the angularity of the gripper rod 60 and consequently little or no effect upon the radial position of the upper gripper mechanism 35 carried by each rod.

As will become apparent the gripper of each sealing unit is caused to lower and raise in timed relation with other of the sealing operations, and the extent or stroke of reciprocation of the gripper may be fixed or it may be adjustable to suit varying requirements. The means for effecting gripper movement through a fixed stroke is illustrated in Figs. 2 and 4, wherein a substantially continuous annular cam track 96 is provided for the purpose, and the means for effecting a variable gripper stroke is represented in Figs. 13 and 24.

With reference to Figs. 2 and 4, the annular cam 96 may be made in sections if desired, and includes a raised portion 97 on which the gripper rods travel during the time the grippers 35 are held considerably above the tube, a low portion 98 on which the gripper rods travel during the time the grippers are in their lowermost position and guiding a tube, and a further raised portion 99 over which the gripper rods travel to effect the release of the drawn off portion of the tubes from the grippers 35. Between the raised portion 97 and the low portion 98 the cam track is provided with a relatively steep incline 100 which effects a lowering of the gripper rods at or about the time the flame is directed against the tube. At the end of the travel along the low portion 98 the gripper rods ride off the fixed cam 98 on the surface 91 of the elevator bracket 90 which is in proper position by the time each gripper rod reaches that point. As the gripper rods progress along the surface 91 of the elevator, the elevator is quickly raised, in this instance by the crank mechanism 87^a to raise the gripper rods to the elevation where they may continue their angular motion on the elevated portion 97 of the cam track. This quick elevation occurs after the grippers have closed on the tube and is the stage at which the tubes are stretched to form part of the sealing operation.

In the embodiment illustrated by Figs. 13 and 24, the above referred to low portion 98 of the annular cam track, is replaced by a vertically adjustable cam member which is herein illustrated as a ring shaped abutment 198. In this preferred form, the abutment 198 is in the form of a sleeve that is mounted upon and normally rotates with the main drive gear unit 72 and coacts successively with each gripper.

The upper rim 198^a of the abutment is radially positioned so as to intercept the descent of the respective gripper rods 60 at a selected point in their travel down the incline 100 by engaging the guide arms 94. Each gripper rod arm 94, as it lowers with its rod 60 is caused to rest upon the rim 198^a at the height to which it has been adjusted, and is carried thereby and therewith to a position over the elevating platform 91. As the latter rises, it engages the roll 93 of the gripper rod and lifts same during the remaining part of the upward stroke. Normally, the elevator 90 has a fixed stroke length which is twice the length of the crank arm 87^a, and in some instances of tube drawing, the fixed stroke provides for too long a pull or stretch. However, by providing a structure wherein the gripper rods may be carried angularly, without lowering or raising, at an adjustable level, an effective means is devised to vary the length of tube stretch.

A further advantage of the variable gripper stroke is that by suspending gripper travel (in an axial direction) until the elevator 90 has been started on its upward travel, the actual time of the tube drawing operation is accelerated. That

is, in the fixed stroke arrangement of Fig. 4, a tube travels angularly $22\frac{1}{2}$ degrees during each complete half turn of the elevating crank 87^a, this being for the full stroke of the gripper. With the adjustable gripper stop 198, the actual vertical movement of the gripper may be delayed until the tube has been moved angularly through part of this $22\frac{1}{2}$ degrees before the elevator 90 will engage the lower end of the gripper rod 60. In other words, so much of the final portion of the elevating stroke may be used to effect the desired contraction and length of pull on a given tube as may be necessary, the initial portion of the crank and elevator motions (in an upward direction) being idle.

The means for adjusting the cam 198 vertically is herein illustrated in the form of three stepped inclines 199 (only one shown) spaced equidistantly about the sleeved portion 200. Three radial pins or screws 201, each threaded into an integral supporting part 202 of the gear 72 support the sleeve in a preselected vertical position, and one or more clamp screws 203 are provided for clamping. The steps in the inclines 199 provide a plurality of relatively closely spaced positions of elevation and serve as a convenient aid in ascertaining the setting required for a given length of gripper stroke.

While a crank mechanism has been illustrated as a means for effecting a substantial and relatively rapid elevation of the grippers at the drawing out stage, a cam or equivalent mechanism may be substituted to perform that function.

With reference more particularly to Figs. 5 and 6, the fuel mixture for the burners enters the distributor head 46 through a central conduit 46^a in a normally stationary coned core 46^b. One or more radiating conduits 46^c conduct the mixture to an annular groove extending around the periphery of the cone at or about the plane of the individual gas connections 45^a that lead to the respective burners. The annular groove just mentioned is made preferably of varying capacity, i. e., of medium cross sectional area at 46^d for that portion of the travel of the burner during which the glass tube is initially heated and softened; a restricted portion 46^e for that portion of the travel of the burner during which the tube is being stretched and cooled; and a portion 46^f relatively large in cross section for that portion of the burner travel during which the drawn tube is severed from the main body and the sealing completed.

In the representative cycle herein illustrated, the portion of minimum cross sectional area, allows just enough fuel gas to enter the particular burner conduit passing at that time as will keep the associated burner lit, but not enough to produce any substantial flame such as would interfere or retard the cooling of the drawn portion. By loosening the set screw 46^e and adjusting the cone 46^b angularly on the stationary shaft 38, the flame reducing portion of the channel may be positioned properly with respect to other and cooperating functions of the apparatus. For tube drawing and sealing that does not require a cooling period between stages, the restricted portion 46^e may be modified accordingly, and other portions of the annular groove modified or proportioned to suit the requirements.

In the present embodiment of the invention, there is also a self-contained air supply and filtering system including the pump 80, an air filter 80^a, and an air chamber 80^b. Air enters the filter through line 80^c and after bubbling through

the liquid in the bowl thereof where dust particles are extracted, it is drawn through the screen therein, and through pipe line 80^c and to the intake side of the pump. Air discharged from the pump passes through a line 80^e to the pulsation dampening chamber 80^b and a line 80^f leads from the top of the chamber to the valve 50 and to a mixing valve 80^g located at the top of the distributor head. Any liquid that may collect in the air chamber 80^b may be drawn off at the bottom through a valve 80^h.

With such a system built into a machine, a supply of clean air is always available to vary the intensity of the burner flame in accordance with the requirement of the glass to be heated as well as to adapt the machine to different grades or qualities of gaseous fuel.

Burner operating mechanism

Normally each burner 44 as it approaches and passes the loading station has its flame end positioned relatively high and out of contact with the tube. This position is represented diagrammatically in Fig. 13 at station marked 1 which may be regarded as the loading station. The raised position of the flame is occasioned by the action of a roller 51^a in coaction with a normally stationary annular cam member 101. As the burner arm rotates about the center 38 the roller tracks the top of the cam and reaches the decline surface 101^a thereof and the flame end 44 is lowered to the proper position on the tube. At or about this point, the size of the flame is automatically adjusted by the distributing head and valve 46 to the intensity required for softening the glass tube. The heating progresses through stations 2 and 3 and just before the grippers take hold and before stretching begins, the flame is reduced and the tube is then immediately stretched out.

During the heating stage the burner roller is riding on the top surface of a vertically adjustable cam carrying plate 102 which is fixed to the shaft 38.

As the stretching of the softened portion of the tube reaches completion, the lower portion is released from the chuck 33 so that the capillary is not twisted off. Meanwhile the burner (with name reduced) is raised by the action of cam surface 103^a of another cam 103, and the burner and non-rotating tube travel through a cooling sector represented at station 5 in Fig. 13. During this cooling period, gases generated within the tube are vented through the capillary portion.

At the completion of the travel through the cooling sector, the burner is lowered to a predetermined point and the flame quickly increased enough to sever the drawn tube at the capillary portion, and then is gradually lowered (by movement along decline 103^b of the cam 103) to fuse and form a balled seal on the needed end of the tube. At the beginning of the sealing operation the severed portion of the tube is again gripped by the lower chuck and rotated. When the seal is completed the burner is lifted by cam surface 104^a of another adjustable cam 104, away from the sealed tube, and the latter cools again. As the turret rotates the burner roller 51^a reaches the incline 101^b of cam 101 and the flame is lifted still further to raise it above the discharge chute 105^a to the elevated position previously mentioned.

In the present embodiment, three independently adjustable cams are employed in the sealing cycle outlined. For a single purpose machine,

a single cam of the proper contour may be devised but where the machine may be used for sealing a variety of tubes the adjustability of individual cams is an important aid in obtaining the correct operating cycle and the correct starting, duration and stopping point of each phase thereof. For example, when sealing a thick walled tube, the flame should be applied to the tube longer and the cam 101 is adjusted back so that the flame lowers sooner. For this purpose the cams 101 and 104 are made relatively extensible, i. e., their total arcuate length may be increased or decreased as desired. To that end, the larger cam 101 is recessed at 101^c to receive a portion of the cam 104, and either end of the extensible cam 101—104 may be advanced or retracted independently or together to produce the required burner action. Each of the cam plates 101, 103, 104 is provided with inwardly projecting flanges arcuately slotted to receive clamping screws 105 by which the respective cams may be clamped to the vertically adjustable plate 102.

Gripper closing mechanism

Starting with the gripper closed (Fig. 8), the lowering of the rod 60, on the portion 100 of the cam track, is timed to occur when the weighted end 68 of the gripper 35, carried by the rod, is directly over a stepped abutment 110 (Figs. 1, 2 and 4). Continued descent of the weighted lever is prohibited by the abutment 110, and therefore the continued downward movement of the rod 60 and the gripper parts, causes the jaws of the gripper to open. The turret, gripper rod 60, and gripper carried thereby are meanwhile rotating, and the end 68 of the gripper actuating lever moves off the top of the fixed abutment 110 and proceeds down the steps 110^a thereof. The steps 110^a maintain the gripper jaws in the open position illustrated in Fig. 1 (at the left) as the whole assembly lowers, and in this way the gripper jaws are held open as they are lowered about the tube end. When the gripper assembly reaches its lowest point (determined by the adjustable abutment 198) the weighted end 68 of the gripper actuating lever is hanging upon the adjustable extension 111 of the abutment 110 and the jaws of the gripper are still held open. Before the tube stretching stage is reached, however, the lever 68 will ride off the inclined end 111^a of the extension 111 and gradually move clockwise (in Fig. 8) about its then stationary pivot 69 and the gripper jaws close on the tube and grips same. This gripping of the tube occurs just before the gripper rod, and its angular travel, reaches the elevating platform and begins to raise.

The gripper actuating abutments 110, 111 and 140 are supported from the center of the machine by a vertically adjustable support 141 (Fig. 1) that surrounds the shaft 88 and is a companion part to the vertically adjustable supporting plate 102. The rotatable block 43 that pivotally mounts the burner arms 51 is journaled intermediate the collar portion of the support 141, and the hub of the cam plate 102, as illustrated in Figs. 1 and 2. The support 141 is also provided with an extension 141^a (illustrated in Fig. 4) to which the lower end of an adjusting screw 142 is secured. The upper end of the screw 142 passes through a hole in a collar 142^a, secured to the shaft 88, and mounts a manually operable wing-nut 142^b. The screw and nut mechanism, just mentioned, affords a convenient means for effecting vertical adjustment of the gripper ac-

tuating abutments 110, 111, and 140, burner arms 51, and supporting plate 102 along the shaft 88 in adapting the machine to a given length tube.

Lower chuck actuating mechanism

As hereinbefore mentioned the lower chuck of each of the tube sealing units comprises a pair of driven rollers 36 and a relatively movable third roller 37. Each roller 36 carries at its underside a gear 36^a and meshes with a stationary annular ring gear 36^b that is supported by a plurality of brackets 36^c. The brackets 36^c are generally U-shaped to provide an opening 36^d between the upstanding legs thereof, through which the roll mounting brackets 36^c may pass in their travels about the stationary gear. The other leg of the brackets 36^c support at their upper ends an annular tube track 36^e on which the lower ends of the tubes *a* rest as they are moved about the axis of the turret. A plurality of supporting rods 36^f support the stationary gear 36^b and the tube track 36^e in fixed spacial relation and concentric with the rotatable main support 70. Each of the rollers 36 has an intermediate bearing portion 36^h that is journaled in a bearing provided in the rotating plate 32 and this bearing in addition to the support provided by the bars 36^f, which are also secured to the rotatable plate 32, maintain the axis of the rolls perpendicular and the gears 36^a thereof permanently in mesh with the fixed gear 36^b. As illustrated more clearly in Figs. 7 and 23, each of the rolls 36 partly overlays the surface of the turret plate 32 which in turn overlays the stationary gear 36^b. In consequence of this overlaying relationship, any bits of glass or other particles of foreign matter that may be picked up by the rolls are caused to be deposited upon the surface of the plate 32 and are prevented from working into the bearing 36^h or into the teeth of the drive gears 36^a and impeding or jamming their action. As the plate 32 rotates the gears of the rollers roll about the fixed gear thus causing the rolls 36 to revolve as they travel about the turret axis. At predetermined points in the sealing cycle the receptacles 33 are caused automatically to open or close thus to release the tube from driving contact of the rolls 36. The opening and closing cycle will depend upon the nature or style of the tube to be sealed. In the present embodiment the receptacle is caused automatically to open and close three times and this is effected by the coaction of one or more cams with a roller 40^a carried by the lever 40 of each tube receptacle at the underside of the rotating plate 32. With reference particularly to Figs. 4, 7 and 13, contour cams 120^a and 121 serve this purpose. Each of these cams is mounted to the underside of the tube track 36^e and supported against movement by the supporting rods 36^f. Fig. 4 illustrates three of the rollers 40^a riding on the periphery of the cam 120 and in the position illustrated the associated tube receptacles 33 are open. With reference to the receptacle at station marked 1 in Fig. 4, the third roller 37 is held some distance away from the rolls 36 permitting the free insertion of a tube. The tube rests upon the underlying tube track 36^e and is carried along to station 2, but before the tube reaches that station the roller 40^a moves down the incline 120^a of the fixed cam and the roller 37 is caused to close upon the tube by the action of the continuous spring 41 and the tube is rotated. At this point the burner is in position to heat the rotating tube, and heating and rotating con-

tinues (through station marked 3) until the tube approaches the station 4 where the tube is stretched out at the softened area into a shape illustrated in Fig. 16. As the tube approaches station 4, the roller 40^a engages the surface 121^a of the cam 121, and is moved outwardly, which movement, through the connected levers 40 and 38 moves the tube engaging roller 37 away from the tube *a*. The tube *a* is thereby released from the grip of the receptacle and is no longer rotating at the time the gripper grips the upper end of the tube and draws out the softened region thereof. During the drawing operation the flame is reduced and remains reduced until the tube reaches station 5 when the flame is again applied to sever the tube at the drawn out portion. Immediately thereafter the receptacle actuating roller 40^a rides off the inclined end 121^b of the cam 121 and the garter spring 41 rocks levers 40 and 38 and the roller 37 against the tube and the latter against the driven rollers 36. The severed tube is thus caused to rotate as the burner flame lowers (along incline 103^b of the cam 103) and finishes the seal. (Station 6.) As the sealing is finished, the burner flame moves upwardly, away from the sealed end of the tube, by reason of the burner supporting roller 51^a engaging the incline 104^a of the cam 104. As the sealed tube approaches station 7, the receptacle actuating roller 40^a engages the cam surface 120^b and again opens the receptacle and releases the tube from the driven rollers 36. Tube rotation then stops permitting examination to be made of the end thereof as it is carried (through station 7) toward the discharge chute 130 at station 8. Fig. 13 illustrates the cycle diagrammatically as well as the relative positions of cooperating elements.

To facilitate the automatic discharge of the sealed tubes the tube track 36^e is provided with an opening 36ⁱ centrally located over the discharge chute 130. As the sealed tube nears the discharge opening, the third roller 37 again closes on the tube by reason of the roller 40^a dropping into a depression 120^c of the fixed cam 120. By so gripping the tube the tube is held against dropping until it is carried to the approximate center of the opening in the tube track where it is released by the engagement of the roller 40^a with an incline 120^d. This final gripping of the tube and carrying it over the brink of the opening to the approximate center thereof insures that the tube does not tip or kant until it is in position to fall freely into the discharge chute. After passing the discharge opening the receptacle closes partially and is ready to receive a new tube. The cams and the operation herein explained is representative of a typical operating cycle and manifestly may be adjusted or varied to suit any particular sealing cycle that the nature of the tubes in hand require or will permit.

Ordinarily, a softened glass tube may be drawn without causing any appreciable lifting of an unclamped bottom portion, but where there may be some irregularity or non-uniformity in wall thickness, each of a series of tubes may not reach the same degree of plasticity during the heating stage and some may lift slightly if unclamped. To guard against such lifting an auxiliary clamping device illustrated by Figs. 22 and 23 may be associated with each sealing unit. This device comprises a lever 150 that is pivoted to each of the roll carrying blocks 36^f and extends upwardly into the V between the drive rolls 36. A sup-

plementary cam 151 mounted to the underside of the tube track 36^e projects inwardly and is engaged by the lower end of the lever 150 at the selected point or points in its travel. As the lever is engaged by the cam and rocked, the upper end thereof moves out of the V between the drive rollers and presses the tube away from the drive rolls and toward the third roller 37 as the latter is moved to its releasing position by the action of one or more of the cams 120, 121. In this way the tube may be released from its driving rollers and at the same time clamped or held against lifting. The amount of movement of the third roller 37 to effect release of a tube from the drive rolls is, it will be understood, quite small, and the amount of movement of the clamp lever 150 is correspondingly small.

Gripper release mechanism

After the upper portion of a tube has been drawn and severed as herein explained, the upper gripper remains elevated and holds the severed portion of the tube out of the way during the completion of the sealing on the lower portion. When the traveling gripper reaches a point just before station 8 the gripper rod 60 rides up a small incline 99 on the cam 96 causing a slight further elevation of the gripper assembly to take place just before the assembly reaches a stationary tripping abutment 140. When the weighted end of lever 68 of the gripper is directly over the abutment 140 the gripper rod 60 drops off of the raised portion 99 of the cam track and leaves the weighted end of lever 68 suspended upon the top of the trip rod 140. The relative movement thus brought about between the gripper rod 60 and the lever 68, causes the gripper to open and release the tube end portion and the latter falls into a chute 105^e and is discharged away from the machine into a receptacle. The continued travel of the turret moves the weight 68 off the abutment 140 and brings the gripper mechanism to the decline 100 in the cam track and to the stepped abutment 110 and the cycle is about to be repeated.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that, from the standpoint of the prior art, fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of the United States:

1. A machine for sealing a partly filled tube comprising a tube receptacle for supporting a partly filled tube at its lower end, said receptacle in part comprising means for rotating the tube about its axis while it is supported thereby, a burner mechanism having a burner tip element positioned adjacent the receptacle for heating the empty portion of the tube close to the contents in the filled portion, a non-rotating gripper positioned above the tube receptacle to loosely guide the upper end of the tube during the heating period, actuating means operatively connected to the gripper for causing said gripper to grip the upper end of the tube at the end of the heating period and thereafter to raise the said

end whereby the heated part of the tube will be elongated and a partial closure formed, means operatively connected to the burner mechanism to render said burner mechanism ineffective prior to the actuation of said gripper mechanism, to further heat the tube; and additional means operatively associated with said tube rotating means for suspending the action of said tube rotating means at the end of the heating period and for continuing said tube rotating means ineffective during the tube-gripping and tube-elongating action of said gripper mechanism, and means operatively connected to said burner mechanism and operative subsequent to said gripping and elongating actuation of said gripper to render said burner effective to sever the filled and empty portions of the tube at the elongated region thereof and to complete the sealing of the filled portion close to the contents.

2. The combination set forth in claim 1 in which said gripper-actuating means includes a crank member normally operative to move said gripper a predetermined distance axially of the tube, a reciprocable gripper supporting rod cooperatively related therewith, said rod having an extension, and an adjustable element interposed in the path of movement of said gripper rod extension to limit the distance said gripper rod is moved in response to the action of said crank member to a selected fraction of said predetermined distance.

3. The combination set forth in claim 1 including means operatively connected with the burner mechanism to adjust the burner tip element of said burner mechanism selectively toward and away from the axis of rotation of the tube.

4. The combination set forth in claim 1 including means operatively associated with the tube rotating means operative shortly after said burner is rendered effective to sever and complete the sealing of the filled portion of the tube to again render said tube rotating means effective.

5. A machine for sealing a partly filled tube comprising a movable carrier, a plurality of tube receptacles for supporting partly filled tubes at their lower ends mounted to said carrier, each of said receptacles in part comprising means for rotating a tube about its axis while it is supported thereby, a carrier-mounted burner mechanism associated with each receptacle having a burner tip element positioned adjacent the receptacle for heating the empty portion of the tube close to the contents in the filled portion during a portion of the movement of the carrier, a normally closed non-rotating gripper mounted to the carrier and positioned above each of the tube receptacles, actuating means operatively connected to each of the grippers for causing said grippers successively to open and to grip the upper ends of the tubes at the end of the respective heating period and thereafter to raise the said ends during a further movement of the carrier whereby the heated part of the tubes will be elongated and a partial closure formed, means operatively connected to each of the burner mechanisms to render each burner mechanism successively ineffective prior to the actuation of said gripper mechanism to heat the tube positioned in its related receptacle, means for

propelling said carrier and parts carried thereby in a closed path, relatively stationary means operatively associated with said tube rotating means during the movement of the carrier for successively suspending the action of each of said tube rotating means at the end of the respective heating periods and for continuing each of said tube rotating means ineffective during the respective tube-gripping and tube-elongating actions of each of said gripper mechanisms; and means operatively connected to each of said burner mechanisms and operative subsequent to said gripping and elongating actuation of said grippers to render the respective burners successively effective to sever the filled and empty portions of the tubes at the elongated regions thereof and to complete the sealing of the filled portions close to the contents.

6. The combination set forth in claim 5 including means common to and operatively connected with all of the said burner mechanisms to adjust the burner tip element of each of said burner mechanisms relative to its associated tube receptacles selectively toward and away from the axis of rotation of the tube.

7. The combination set forth in claim 5 including means operatively associated with the tube rotating means of each receptacle and operative shortly after each of said burners is rendered successively effective to sever and complete the sealing of the filled portion of the tube to again render the tube rotating means of each receptacle effective in succession.

8. A machine for sealing a partly filled tube comprising a tube receptacle for supporting a tube at its lower end, said receptacle in part comprising normally operative means for rotating the tube about its axis while it is supported thereby, a movable burner mechanism having a burner tip element positioned adjacent the receptacle for heating the tube intermediate its ends, a normally closed non-rotating gripper positioned above the tube receptacle, actuating means operatively connected to the gripper for causing said gripper to open and to grip the upper end of the tube at the end of the heating period and thereafter to raise the said end whereby the heated part of the tube will be elongated and a partial closure formed at the heated region, means operatively connected to the burner mechanism to render said burner mechanism ineffective prior to the actuation of said gripper mechanism to further heat the tube and additional means operatively associated with said tube rotating means for suspending the action of said tube rotating means at the end of the heating period and for continuing said tube rotating means ineffective during the tube-gripping and tube elongating action of said gripper mechanism, and means operatively connected to said burner mechanism and operative subsequent to said gripping and elongating actuation of said gripper to render said burner effective to sever the tube at the elongated region thereof and to complete the sealing of the portion held in the receptacle.

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