May 10, 1949. G. GUIGAS 2,469,597

METHOD OF AND APPARATUS FOR HEATING, SIZING, OR FORMING QUARTZ TUBES AND PROFILES

Filed Feb. 1, 1946 4 Sheets-Sheet 1

Fig. 1.

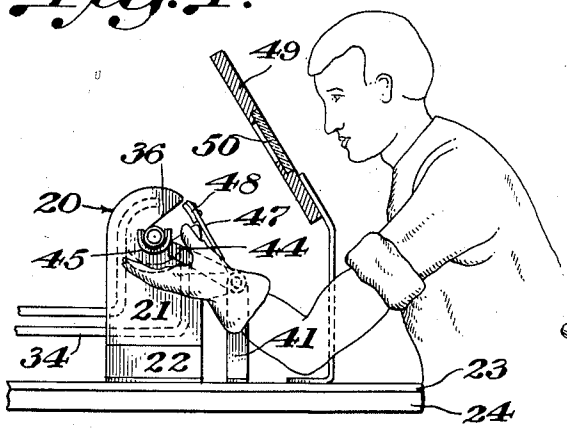


Fig. 5.

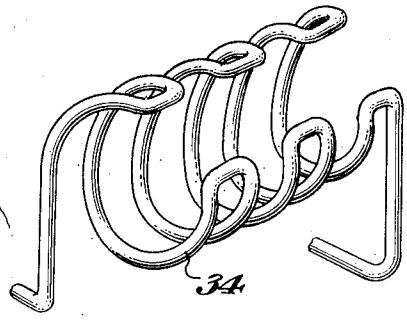


Fig. 2.

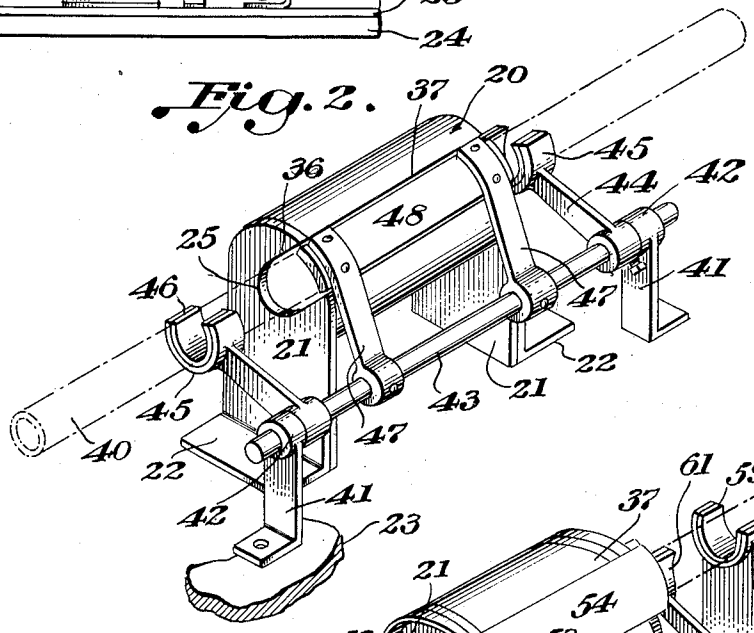
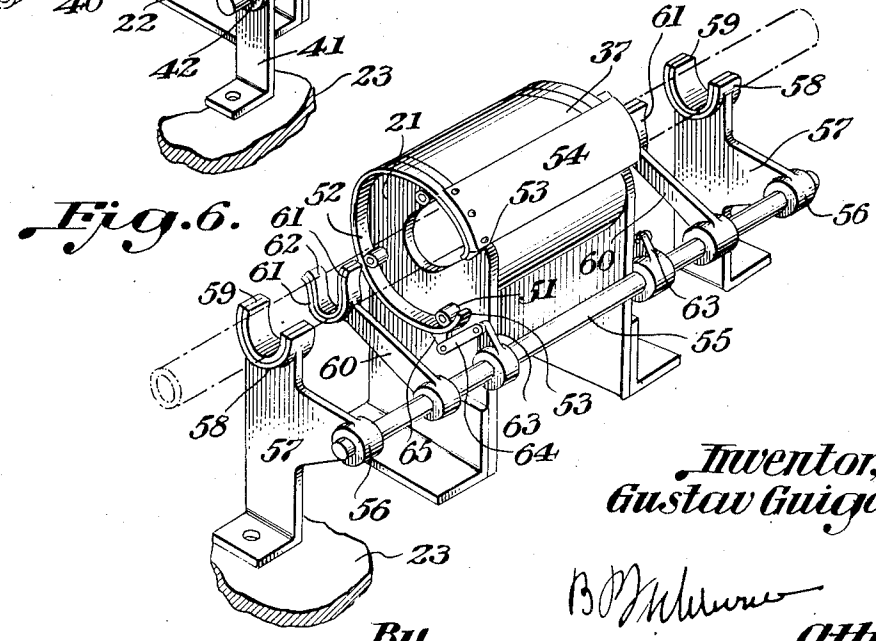


Fig. 6.



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Fig. 3.

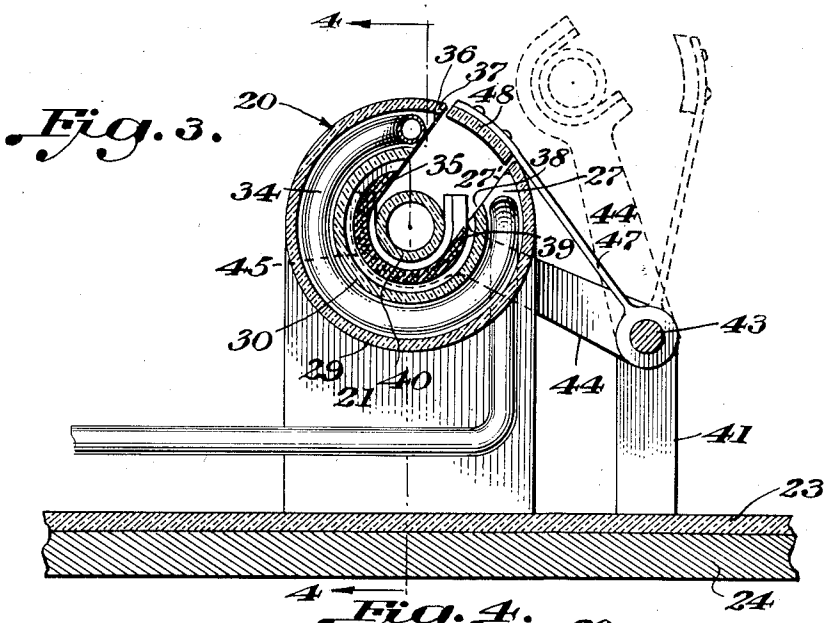


Fig. 4.

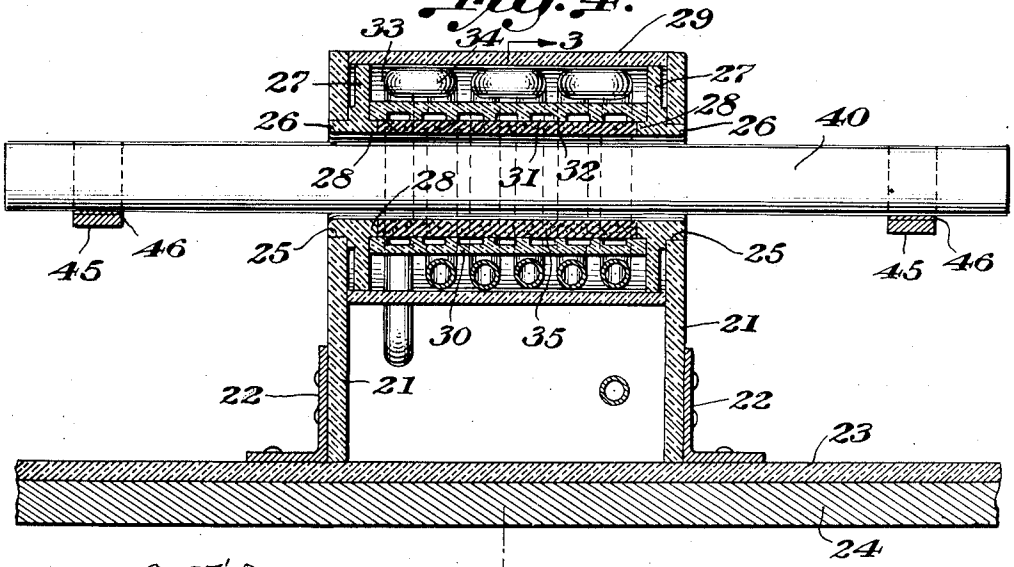
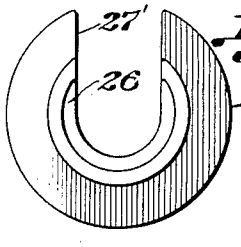


Fig. 12.



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METHOD OF AND APPARATUS FOR HEATING, SIZING, OR FORMING QUARTZ TUBES AND PROFILES

Filed Feb. 1, 1946 4 Sheets-Sheet 3

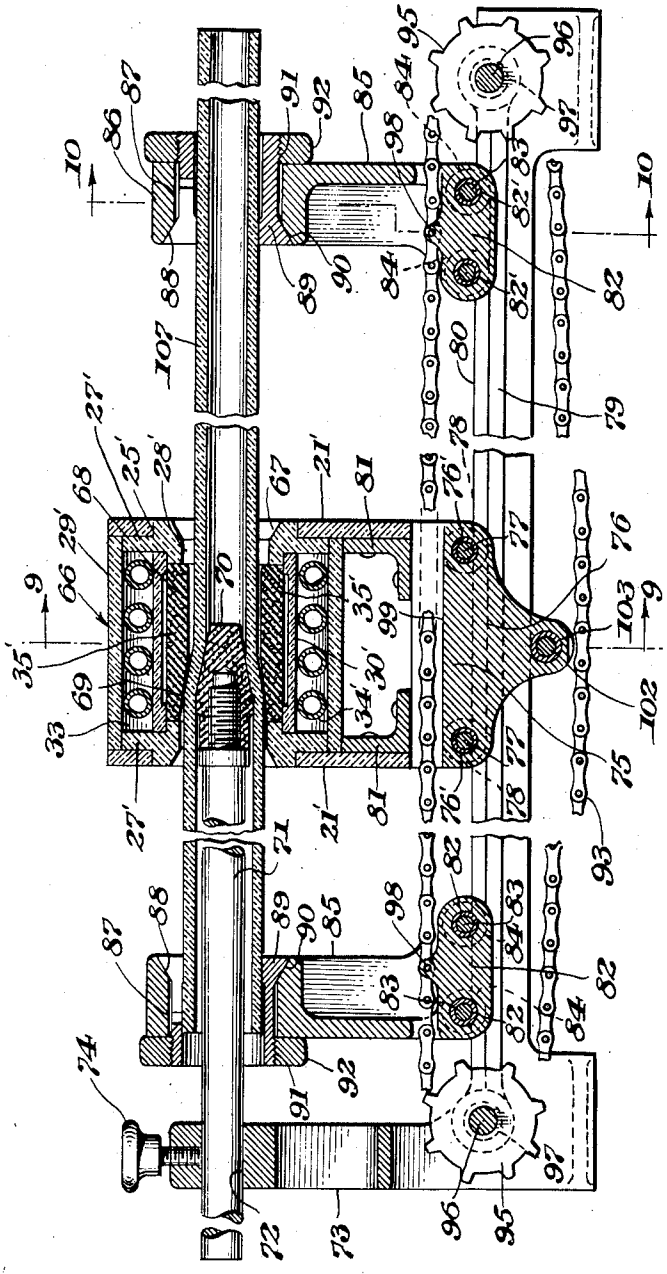


Fig. 7.

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METHOD OF AND APPARATUS FOR HEATING, SIZING, OR FORMING QUARTZ TUBES AND PROFILES

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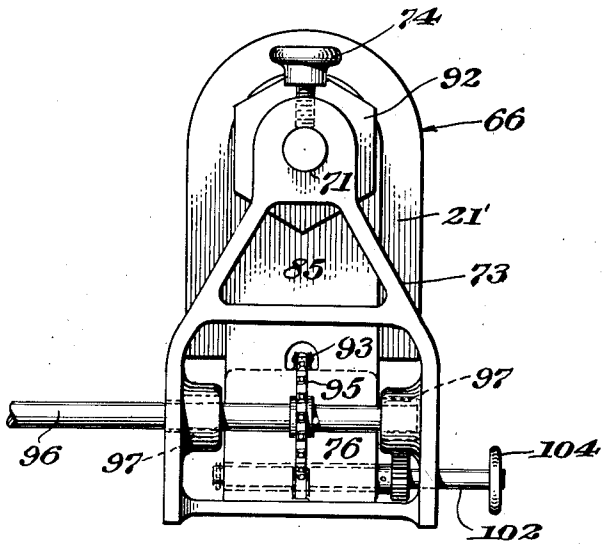


Fig. 8.

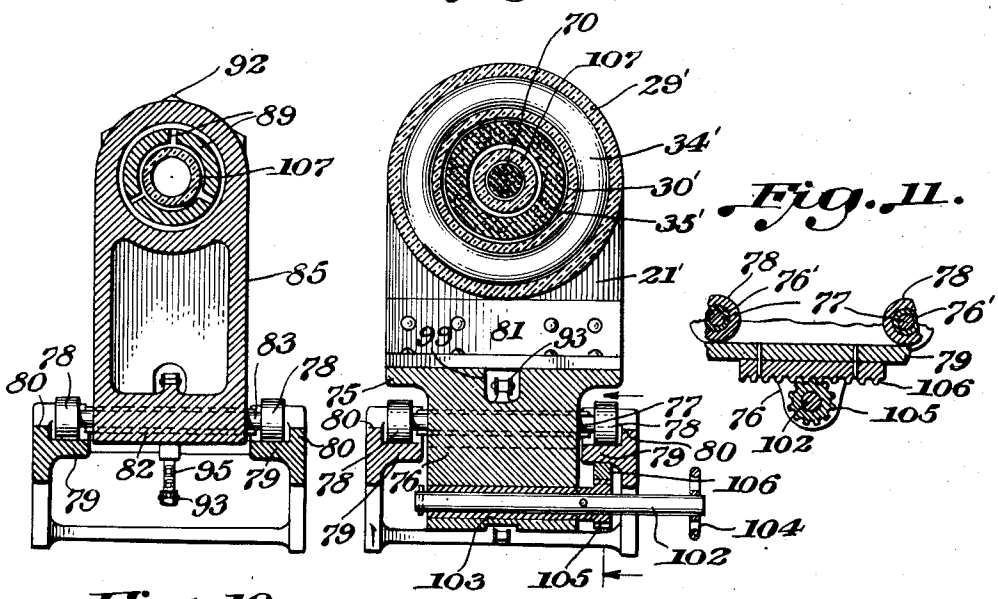


Fig. 11.

Fig. 10.

Fig. 9.

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Patented May 10, 1949

2,469,597

UNITED STATES PATENT OFFICE

2,469,597

METHOD OF AND APPARATUS FOR HEATING, SIZING, OR FORMING QUARTZ TUBES AND PROFILES

Gustav Guigas, Livingston, N. J.

Application February 1, 1946, Serial No. 644,704

14 Claims. (Cl. 49—7)

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My invention relates to a method of and apparatus for heating, sizing, or forming quartz tubes and profiles.

An important object of the invention is to provide electrically operated means for heating the quartz tubes or profiles, thus eliminating the objectionable gas oxygen burner, which burner produces a method which is slow, costly and noisy.

A further object of the invention is to provide apparatus of the above mentioned character so constructed that the quartz tube or profile may be quickly and easily introduced into the electric heating unit or furnace and may be conveniently manipulated therein for heating, sizing, or forming.

A further object of the invention is to provide a cover automatically moved in position to close the opening in the side of the electric heating unit, after the tube or profile has been introduced into the heating unit.

A further object of the invention is to provide apparatus of the above mentioned character which is compact and relatively simple in construction and cheap to manufacture.

A further object of the invention is to provide apparatus of the above mentioned character so constructed that the adjustment of the heat in both the heating shell and mandrel may be obtained by shifting the mandrel into and out of the magnetic field.

A further object of the invention is to provide apparatus of the above mentioned character which is automatic, to some extent.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this application, and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is an end elevation of apparatus embodying my invention,

Figure 2 is a perspective view of the same,

Figure 3 is a transverse section taken on line 3—3 of Figure 4,

Figure 4 is a longitudinal section taken on line 4—4 of Figure 3,

Figure 5 is a perspective view of the high frequency tubular coil,

Figure 6 is a perspective view of a device embodying a modified form of the invention,

Figure 7 is a central vertical longitudinal section through apparatus embodying a further modification of the invention,

Figure 8 is an end elevation of the same,

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Figure 9 is a transverse section taken on line 9—9 of Figure 7,

Figure 10 is a similar view taken on line 10—10 of Figure 7,

Figure 11 is a longitudinal vertical section taken on line 11—11 of Figure 9 and,

Fig. 12 is a side elevation of a circular disc.

In the drawings, wherein for the purpose of illustration are shown preferred embodiments of my invention, attention being called first to Figures 1 to 5 inclusive, the numeral 20 designates an electrical heating unit or furnace as a whole. This heating unit comprises vertical ends 21 formed of refractory material. These ends are secured in place by brackets 22, rigidly attached thereto, and these brackets are rigidly mounted upon a horizontal refractory base 23, mounted upon a table top 24 or the like.

The ends 21 are provided near their tops with circularly curved openings 25 for receiving outer annular flanges 26, integral with circular discs 27, formed of refractory material. These circular discs also have inner circularly curved flanges 28. Arranged between the ends 21 is an outer cylindrical casing 29, formed of refractory material, and this casing receives the discs 27, and is held in place thereby. The numeral 30 designates an inner cylindrical casing, arranged between the disc 27 and receiving the inner flanges 28, and held in place thereby. This inner casing is provided upon its inner surface with circumferentially extending grooves 31, providing ribs 32. The inner casing 30 is arranged in spaced concentric relation to the outer casing 29, affording a cylindrical chamber or space 33, for receiving a tubular water cooled high frequency coil 34, preferably formed of copper. This coil extends circumferentially around the major portion of the circumference of the inner casing 30, but is shaped to provide a main longitudinal side opening or passage, Figure 5. A coolant is passed through the coil 34 and the opposite ends of the coil are connected with a suitable source of high frequency current.

The numeral 35 designates a heating tubular shell, formed of carbon or graphite, or a mixture of the same, or any other suitable material. This heating shell is arranged between the ends of the flanges 26 and is positioned within the inner refractory casing 30 and is held in place thereby. The elements 29, 30, and 35 are all retained in concentric relation.

The ends 21 have vertically inclined radial openings 36, which lead to the circularly curved openings 25. The discs 27 have inclined radial

openings 27', in registration with the openings 36. The outer casing 29 has a longitudinal opening 37, the inner casing has a longitudinal opening 38, and the heating shell 35 has a longitudinal opening 39. These longitudinal openings are in alignment and permit of the quartz tube or profile 40 being shifted laterally into and out of the heating shell 35.

Rigidly mounted upon the sheet or base 23 are vertical brackets 41, provided at their tops with bearings 42, for receiving a horizontal rock shaft 43. Rigidly mounted upon the rock shaft 43 are radial swinging arms 44, provided at their free ends with U-shaped sockets 45, preferably having linings 46 of refractory material. These sockets face upwardly and are open at their tops and are substantially vertical when the arms are in the rearmost position. Rigidly mounted upon the rock shaft 43 are radial arms 47, to the free ends of which are rigidly secured a door or cover 48, adapted to enter the longitudinal opening 37. This door or cover is formed of refractory material and when in the closed position, will cover the opening 37 and properly confine the heat within the heating unit or furnace.

Arranged in front of the heating unit or furnace 20 is a protecting screen 49, having a dark glass window 50.

The operation of the apparatus is as follows:

The arm or arms 44 are grasped by the operator and swung forwardly and may be held in the forward position. The current is turned on, and the high frequency coil 34 induces current in the carbon heating shell 35, which is heated to a bright heat. The operator then places the quartz tube or profile 40 within the sockets 45 and then swings the arms 44 rearwardly. These arms move the tube laterally through the several longitudinal openings 37, 38, and 39 and position the same within the carbon heating shell 35, in spaced concentric relation thereto. When the arms 44 are moved rearwardly the arms 47 are also moved rearwardly and the door 48 covers the opening 37, and the turning movement of the rock shaft is limited by the arms 47 contacting with the outer casing 29. The tube 40 is thus supported within the heating shell 35, and may be turned, moved longitudinally or otherwise manually manipulated by the operator, who may observe the operation through the dark window 50. The heat from the shell 35 heats the tube 40, which may be plasticized for sizing or forming The extent of the heat treatment of the tube 40 would of course be regulated by the point to which the shell 35 is heated and also to the length of time that the tube remains within the heating shell. The tube, during the heat treatment, may be readily shifted to the exterior of the heating unit for inspection, and returned therein.

In Figure 6, I have shown a modification of the invention. In this figure, the ends 21 have rollers 51 arranged upon their outer sides and rotatably mounted thereon. These rollers support circularly curved rails 52, having stops 53, forming a passage between them. Rigidly secured to corresponding ends of these rails is a door 54, formed of refractory material, and arranged to travel circumferentially of the outer casing 29, exteriorly thereof. This door is adapted to cover the longitudinal opening 37 of the casing 29.

The numeral 55 designates a horizontal rock shaft, journaled in bearings 56, formed upon vertical brackets 57, rigidly attached to the sheet 23. These brackets are provided at their upper ends with upwardly facing U-shaped sockets 58, having linings 59 of refractory material. Radial arms 60 are rigidly secured to the rock shaft 55 and have upstanding U-shaped sockets 61, having linings 62 of refractory material. Rigidly secured to the rock shaft 55 are cranks 63, pivotally connected with links 64, pivoted to extensions 65, rigidly secured to the rails 52.

All other parts of the apparatus remain identical with those shown and described in connection with the first form of the invention.

In the operation of this form of the invention, the arms 60 are manually swung forwardly, which turns the rock shaft 55, and this rock shaft actuates the links 64, which cause the rails 52 to travel upon the rollers 55. The door 54 travels circumferentially and exteriorly with respect to the casing 29 and uncovers the opening 37. The tube 40 is introduced into the sockets 61 and when the arms 60 are swung rearwardly, the tube passes laterally into the heating shell and also enters the sockets 58 and is held thereby in spaced concentric relation to the heating shell 35. The heating shell heats the tube which is plasticized and may be formed or sized.

In Figures 7 to 11 inclusive, I have shown a further modification of the invention. In these figures, a heating unit or furnace 66 is shown, including ends 21', corresponding to the ends 21, and discs 27' corresponding to the discs 27. An outer casing 29' is provided, corresponding to the outer casing 29, an inner casing 30', corresponding to the casing 30 and a tubular heating, sizing or forming shell 35', corresponding somewhat to the heating shell 35. There is a tubular high frequency coil 34', corresponding to the coil 34, arranged within the space 33'. These parts are assembled in the identical manner as described in connection with the first form of the invention. The ends 21' do not have the radial slots and these ends are closed except for circular openings 25'. The discs 27' do not have the radial slots and are closed except for the central openings 28'. The outer casing 29' does not have the longitudinal slot 37 and the inner casing 30' does not have the longitudinal opening 39. These outer and inner casings have continuous peripheries and are open at their ends. The tubular heating shell 35' does not have the opening 39 and its periphery is continuous, while its ends are open. The discs 27' have inclined or beveled faces 67. The heating shell 35' has a cylindrical bore 68, leading into a tapered portion 69, flaring outwardly. The heating shell 35' is formed of carbon, graphite, or the like.

The numeral 70 designates a forming or expanding mandrel, which is longitudinally tapered, increasing in diameter outwardly. This mandrel may be formed of carbon or graphite. This mandred is arranged to enter the bore of the heating shell 35', and is smaller in diameter than the heating shell 35' in diameter, and is arranged in spaced concentric relation to the heating shell. The mandrel 70 is rigidly mounted upon a horizontal supporting rod 71, mounted within an opening 72 formed in a stationary bracket 73, and clamped in the selected adjusted position by a set screw 74.

The numeral 75 designates a carriage having a depending portion 76, preferably formed integral therewith. This depending portion has bearings 76', receiving transverse shafts 77, carrying wheels 78. These wheels are arranged to travel upon a stationary track including horizontal rail 79, having upstanding guide flanges 80. The ends 21'

are rigidly mounted upon the carriage 75 by brackets 81.

Disposed upon opposite sides of the carriage 75 are carriages 82, having bearings 82', receiving transverse shafts 83, carrying wheels 84, traveling upon the horizontal rails 79. Mounted upon these carriages and preferably formed integral therewith are vertical posts 85. Each post 85 is equipped with an adjustable chuck, including a tubular socket 86, formed integral therewith. This tubular socket has a cylindrical bore 87, having a tapered portion 88. Slips 89 are mounted in the cylindrical bore 87 and have tapered portions 90 to engage with the tapered bore portion 88, and these slips are screw threaded, as shown at 91, for engaging a clamping ring 92. These adjustable chucks are adapted for clamping engagement with the tube to be heated, for moving the same longitudinally.

Means are provided to cause the carriages 82 to move longitudinally in unison, comprising an endless sprocket chain 93, passing about sprocket wheels 95, carried by shafts 96, journalled in fixed bearings 97. One shaft 96 is power driven. This sprocket chain is horizontally arranged and its upper run is attached to the carriages 82, as shown at 98. This upper run extends through a horizontal passage 99 formed in the depending portion 76 and is free from connection with the carriage 75.

Means are provided to shift the heating unit 66 and carriage 75 longitudinally, comprising a transverse horizontal shaft 102, journalled in a bearing 103, formed in the depending portion 76. This shaft projects outwardly beyond one side of the carriage and the tracks and is equipped with a hand wheel 104. The shaft 102 has a pinion rigidly mounted thereon, engaging a stationary rack 106, which is rigidly attached to the adjacent rail 79. By turning the hand wheel 104, the pinion 105 will travel upon the rack 106, thereby causing the carriage to be adjusted longitudinally in the desired direction. Any suitable means may be employed to hold the shaft 102 against improper turning movement.

The operation of the last form of the invention is as follows:

The clamping nuts 92 are unscrewed so that the chucks are expanded. The quartz tube 107 is passed through the right chuck, Figure 7, and its free end introduced into the end of the heating shell 35' and brought into contact with the reduced end of the tapered mandrel, which projects in the same for a short distance. The current is turned on and the high frequency coil heats the tubular shell 35' and the mandrel 70 to to a bright heat. The mandrel 70 remains stationary and the carriage 75 is stationary during the sizing or forming. The carriage 75 may be longitudinally adjusted with relation to the mandrel to vary the distance between the mandrel 70 and the tapered bore portion 69, to regulate the extent of forming or sizing. This adjustment also brings the mandrel different distances into the heating shell 35' and this has been found to regulate the degree of heat of the furnace, to a certain extent. With the mandrel 70 and heating unit or furnace held stationary, the tube may be manually fed into the right end of the heating shell 35' and through this heating shell and about the mandrel 70 and becomes sized or formed to a larger diameter. The plasticized portion of the tube now passes beyond the left end of the furnace 66 and will freeze and may be brought into the left chuck. The current may be turned off, while

the tube is being clamped within the chucks, which is the next step. The heat is again turned on and the two carriages 82 are moved in unison to the left longitudinally of the mandrel. The sizing or forming of the tube about the mandrel 70 is continuous during the travel of these carriages. The carriages 82 push and pull the tube. The operation is continued until the carriage 82 to the right reaches a point near the furnace 62. When this occurs the current is turned off, the heating unit 66 is shifted to the right to uncover the mandrel 70. When the plasticized portion of the tube adjacent to the mandrel 70 freezes, the short right end of the tube may be cracked off, and the formed tube separated from the mandrel.

It is to be understood that the forms of my invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim is:

1. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a heating unit, said heating unit comprising a heating shell to be heated by electrical induction, said heating shell having a side opening, a high frequency coil surrounding the heating shell and having a side opening disposed adjacent to the first named side opening, the quartz tube to be heated being passed laterally through the side openings into the heating shell.

2. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a refractory casing including an outer casing, an inner casing, a tubular heating shell arranged within the inner casing, the outer casing, inner casing and tubular shell having side openings in substantial alignment, and a tubular high frequency coil arranged between the outer and inner shells, the tube being moved into the tubular heating shell by a lateral movement of the same.

3. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a refractory casing including outer and inner casings, a tubular heating shell arranged within the inner casing, the outer casing, inner casing and tubular shell having side openings in substantial alignment, a high frequency coil arranged between the outer and inner shells, the tube being moved into the tubular heating shell by a lateral movement, and means to support the tube when introduced into the tubular heating shell.

4. Apparatus for heating, forming and sizing quartz tubes or the like, comprising a heating unit including a refractory housing, said housing comprising ends having openings, discs arranged upon the inner sides of the ends and provided with openings and having outer flanges to enter the openings and inner flanges, an outer casing arranged between the ends and surroundings the discs and held in place thereby, an inner casing arranged between the discs and spaced from the outer casing and engaging the inner flanges and held in place thereby, high frequency coil arranged between the inner and outer casings, a tubular heating shell arranged between the inner flanges and held in place by the inner casing, the outer and inner casings and the heating shell have openings in their sides and the ends and discs having radial openings leading to their first named openings, the tube being

moved into the tubular heating shell by a lateral movement.

5. Apparatus for heating, forming and sizing quartz tubes or the like, comprising a refractory housing including ends having openings, discs disposed upon the inner sides of the ends and provided with openings and having outer flanges to enter the openings of the ends and having inner flanges, an outer casing arranged between the ends and engaging the discs and held in place thereby, an inner casing spaced from the outer casing and arranged between the ends and engaging the inner flanges to be held in place thereby, a high frequency coil arranged between the outer and inner casings, a tubular heating shell to be heated by electrical induction arranged within the inner casing between the inner flanges and held in place by the inner casing, and means for introducing the tube into the tubular heating shell.

6. Apparatus for heating, forming and sizing quartz tubes or the like, comprising a refractory housing, said housing having a side opening, a tubular heating shell held within the housing to be heated by electrical induction and having a side opening, a movable door to cover the side opening in the tubular heating shell, and means for supporting the tube when introduced into the tubular heating shell.

7. Apparatus for heating, forming and sizing quartz tubes or the like, comprising a refractory housing having a side opening, a tubular heating shell arranged within the refractory housing to be heated by electrical induction and having a side opening, a door to cover the side opening in the tubular heating shell, means to receive the tube and introduce the same into the tubular heating shell through the side openings, and means connecting the door with the first named means so that the door is moved by the first named means.

8. Apparatus for heating, forming and sizing quartz tubes or the like, comprising a refractory housing having a side opening, a tubular electrical heating shell arranged within the housing to be heated by electrical induction and having a side opening, a rock shaft, means mounted upon the rock shaft for holding the tube and passing the same into the heating shell through the side openings, a door to cover the side opening of the tubular heating shell, and operating means connecting the door and rock shaft.

9. Apparatus for heating, forming or sizing quartz tubes or the like, comprising an electrical heating unit including a refractory housing, said housing comprising a periphery and ends, said periphery having a side opening and the ends having radial openings, a tubular heating shell arranged within the housing to be heated by electrical induction and having a side opening, a coil to heat the heating shell, a rock shaft arranged near and upon one side of the housing, arms secured to the rock shaft and arranged near and outwardly of the ends and having sockets to receive the tube, the sockets being adapted to pass the tube into the tubular heating shell, a cover, and arms carrying the cover and mounted upon the rock shaft.

10. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a refractory housing including a periphery and ends, said periphery having a side opening and the ends having radial openings, a tubular heating shell arranged within the housing and having a side opening, a high frequency coil arranged within the housing adjacent to the tubular heating shell, a rock shaft disposed upon one side of the periphery, arms mounted upon the rock shaft and arranged near and upon the outer side of the ends and having sockets to receive the tube and move the same into the tubular heating shell, guide means mounted upon the housing, rails mounted to travel upon the guide means, a door to cover the side opening in the tubular heating shell and carried by the rails, and operating connecting means between the rails and rock shaft.

11. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a refractory housing including a periphery and ends, said periphery having a side opening and the ends having radial openings, a tubular heating shell arranged within the housing and having a side opening, a coil arranged within the housing adjacent to the tubular heating shell, a rock shaft disposed upon one side of the periphery, arms mounted upon the rock shaft and arranged near and upon the outer sides of the ends and having sockets to receive the tube and move the same into the tubular heating shell, guide means mounted upon the housing, rails mounted to travel upon the guide means, a door to cover the side opening in the tubular heating shell and carried by the rails, operating connecting means between the rails and rock shaft, and stationary sockets to receive the tube when it is introduced into the tubular heating shell.

12. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a heating unit including a refractory casing, a tubular heating shell to be heated by electrical induction arranged within the casing and having a tapered forming bore, the tapered forming bore increasing in diameter toward its outlet end, a tapered forming mandrel to enter the tapered forming bore of the tubular heating shell, the tapered forming mandrel increasing in diameter toward the outlet end of the tapered forming bore and having a reduced end smaller than the normal diameter of the tube and a large end having a greater diameter than such normal bore; a coil arranged adjacent to the tubular heating shell, carriages arranged upon the opposite sides of the heating unit, means mounted upon the carriages to receive and hold the tube and move the same longitudinally, and means to move at least one carriage, the arrangement being such that the tapered forming mandrel increases the diameter of the plasticized portion of the tube when the tube is moved longitudinally and presses the outer face of the tube into contact with the tapered forming bore for forming such outer face.

13. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a heating unit including a refractory casing, a tubular heating shell mounted within the refractory casing and having a tapered forming bore and adapted to be heated by electrical induction, said tapered forming bore increasing in diameter toward its outlet end, a coil arranged adjacent to the tubular heating shell, a tapered forming mandrel to enter the tapered forming bore of the tubular heating shell, the tapered forming mandrel having a reduced end of smaller diameter than the original bore of the tube and a large end of greater diameter than such bore, adjustable means to effect a relative longitudinal movement between the mandrel and tubular

heating shell, and means to support the tube and moveable longitudinally of the mandrel, the arrangement being such that the tapered forming mandrel increases the bore of the plasticized portion of the tube when the tube is moved longitudinally over it and presses the outer face of the tube into contact with the tapered forming bore of the tubular heating shell for forming such outer face.

14. Apparatus for heating, forming or sizing quartz tubes or the like, comprising a track, a carriage mounted upon the track to move longitudinally thereof, a heating unit mounted upon the carriage and including a refractory housing, a tubular heating shell mounted within the housing and adapted to be heated by electrical induction and having a tapered forming bore which increases in diameter toward its outlet end, a tapered forming mandrel to enter the tapered forming bore of the tubular electrical heating shell, the tapered forming mandrel increasing in diameter toward the outlet end of the tapered forming bore and having a reduced end of smaller diameter than the original bore of the tube and an enlarged portion of a greater diameter than such original bore, means to hold the mandrel stationary, coil disposed in cooperative relation to the tubular heating shell and the mandrel, means to move the carriage longitudinally of the track, carriages mounted upon the track to travel longitudinally thereof and arranged upon the

opposite sides of the heating unit, means carried by the last named carriages for receiving and holding the tube, and means to move the carriages, the arrangement being such that the tapered forming mandrel increases the diameter of the bore of the plasticized portion of the tube when the tube is moved longitudinally and also presses the outer face of the tube into contact with the tapered forming bore of the heating shell for thereby forming such outer face.

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