

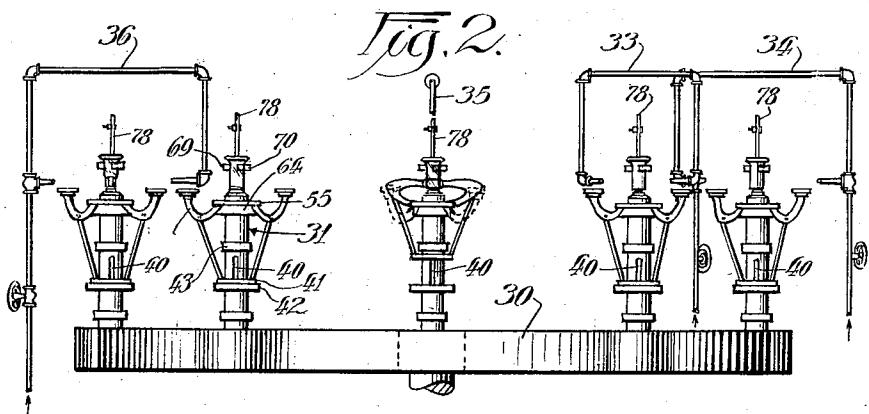
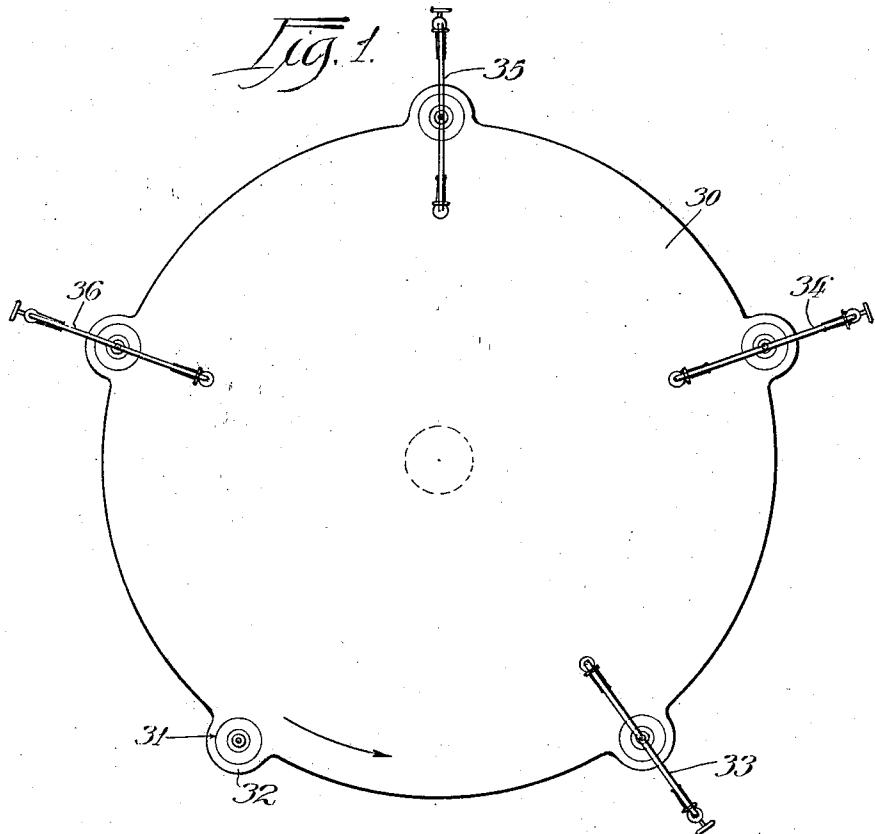
April 12, 1932.

G. D. McCABE

1,853,911

STEM PRESSING APPARATUS

Original Filed Oct. 31, 1930 4 Sheets-Sheet 1



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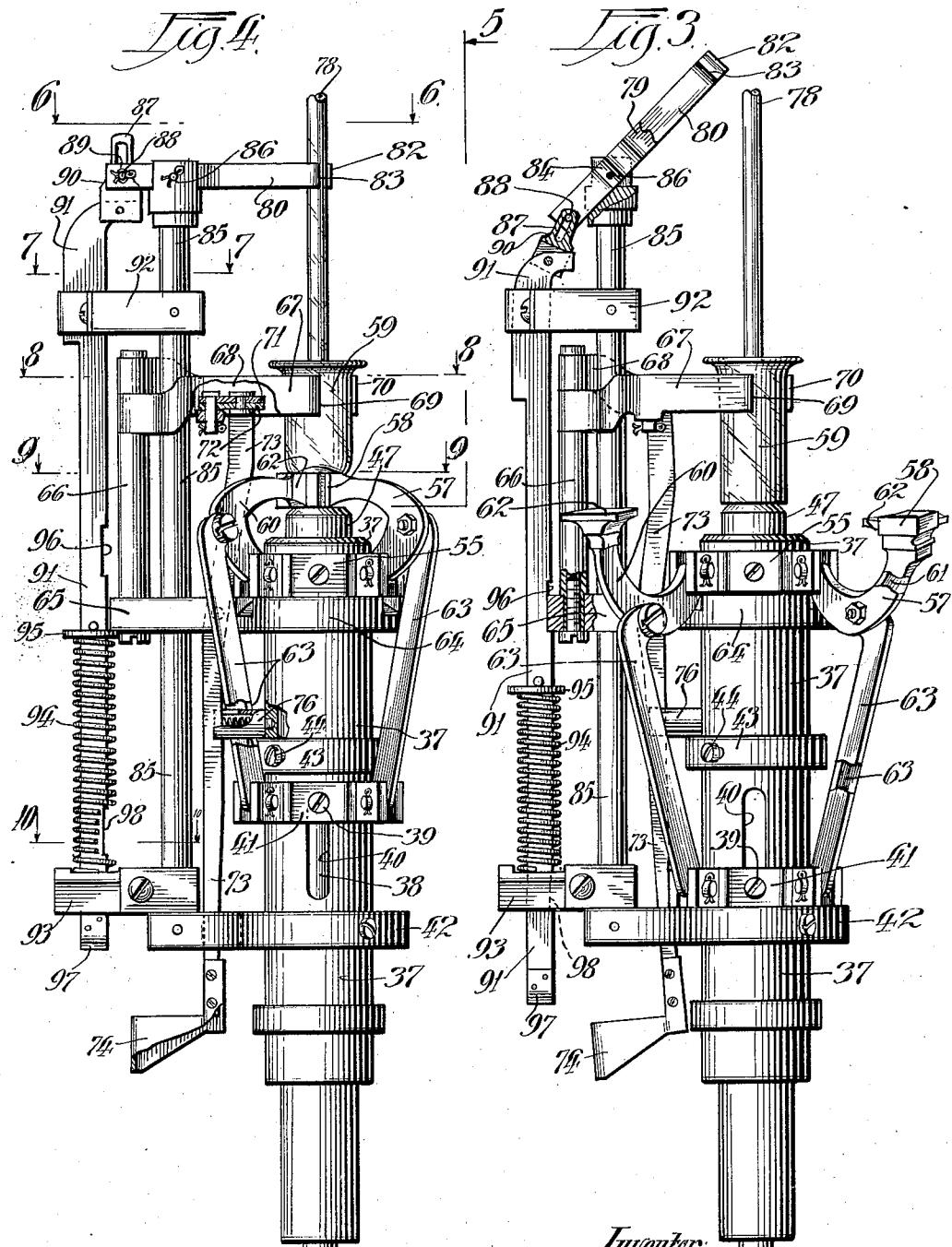
April 12, 1932.

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STEM PRESSING APPARATUS

Original Filed Oct. 31, 1930 4 Sheets-Sheet 2



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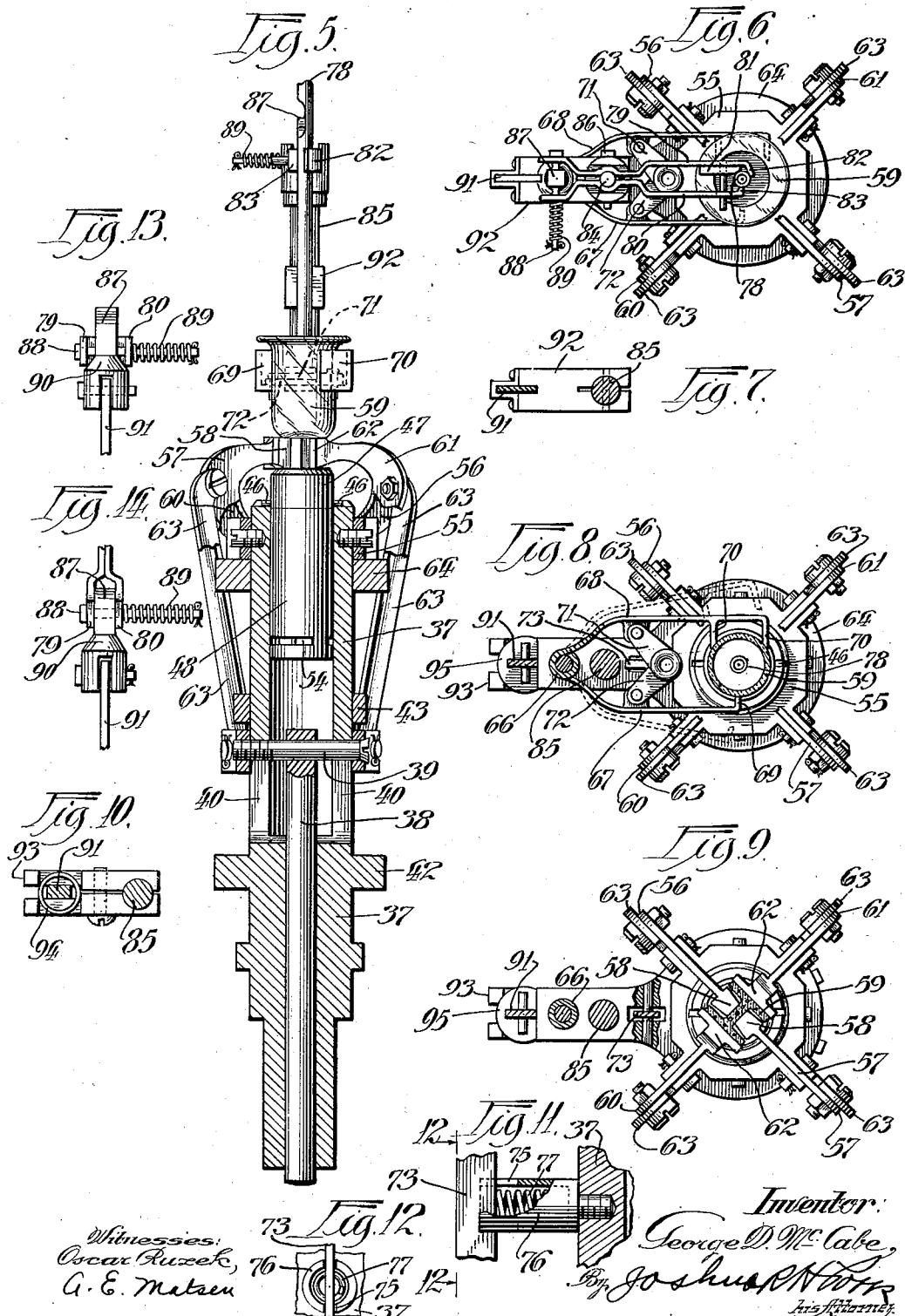
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1,853,911

## STEM PRESSING APPARATUS

Original Filed Oct. 31, 1930 4 Sheets-Sheet 3



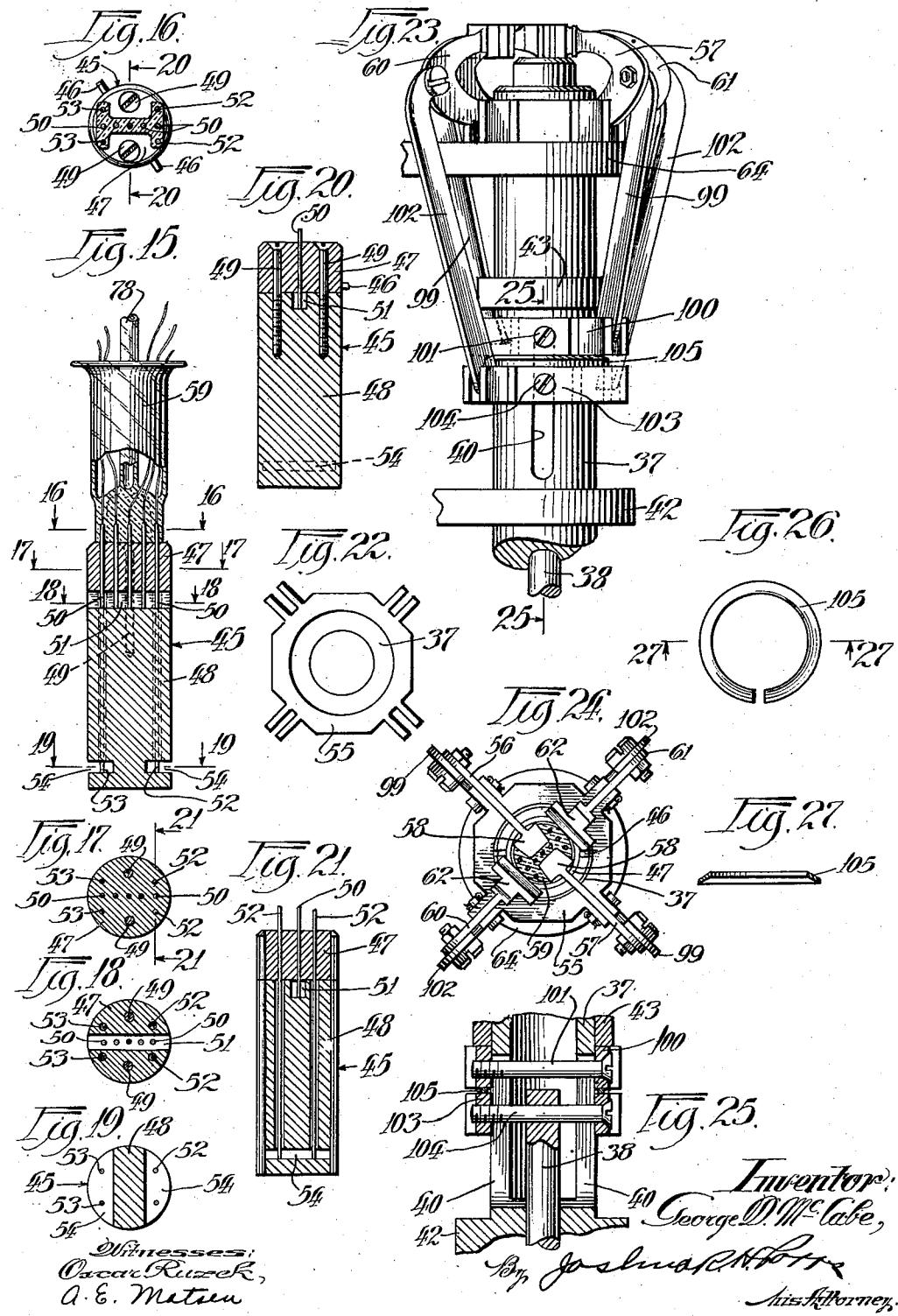
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### STEM PRESSING APPARATUS

Original Filed Oct. 31, 1930 4 Sheets-Sheet 4



## UNITED STATES PATENT OFFICE

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## STEM PRESSING APPARATUS

Application filed October 31, 1930, Serial No. 492,446. Renewed February 15, 1932.

This invention relates to stem pressing apparatus, and more particularly apparatus or mechanism for pressing and sealing the element supporting stem of tubes, such as vacuum tubes, gas enclosed tubes, and the like. A more particular object resides in the provision of mechanism of the character indicated to produce an improved sealing construction in the element supporting stem of tubes to obtain a more effective and uniform sealing action between the compressed or molded glass or equivalent material forming the stem, and the element supporting members or wires. An additional object is the provision of stem forming mechanism constructed and arranged to produce element supporting stems having the supporting members or wires disposed in a relationship whereby increased support for the elements is afforded, and bending or distortion of the supports prevented. An additional object resides in the provision of improved stem forming mechanism whereby the glass compressing members act in a direction perpendicular to the planes in which the element supporting members are disposed for the purpose of avoiding a sliding action in the molten glass. The result of this construction and arrangement is to effect a tighter seal or cohesion between the compressed glass and the embedded element supporting members or wires, and to prevent leakage, as well as to prevent internal strains in the glass.

The apparatus of the present invention is especially designed for the formation of element supporting and holding stems of radio vacuum tubes, although it is to be understood that it is not to be restricted thereto, but is of advantage in connection with forming stems of other tubes, such as gaseous rectifiers, photo-electric cells, ultra-violet ray lamps, incandescent lamps, mercury vapor lamps, mercury switches, X-ray tubes, gaseous illuminating signs, etc.

A further object is the provision of improved stem clamping mechanism, as well as the provision of improved exhaust tube clamping mechanism. In radio tube construction, for example, the element supporting members, such as the wires which sup-

port the plate and grid elements, are positioned substantially in alignment or in the same plane. These supporting wires are constructed of soft metal such as nickel wire, and any sudden jarring has a tendency to cause a bending at the point of juncture with the stem. This presents a difficulty in connection with transporting and handling tubes before they are actually put to use, inasmuch as any slight bending or distortion will set up microphonics and directly impair the efficiency of the tube. An additional object of the present invention, therefore, is the provision of a stem forming head designed to form a supporting stem in which the primary supporting wires are supplemented by secondary wires disposed laterally with respect to the primary wires whereby, upon placing a connection between the two, bending or distortion of the primary supporting wires is prevented by the lateral supports afforded by the secondary wires.

Other objects will appear hereinafter.

The invention consists in the combinations and arrangements of parts hereinafter described and claimed.

The invention will be best understood by reference to the accompanying drawings forming a part of this specification, and in which:

Fig. 1 is a plan view of a revolving table of a type that may be used in conjunction with the forming head or apparatus of the present invention;

Fig. 2 is an elevational view of the table shown in Fig. 1, with a plurality of stem forming heads of the present invention mounted thereon;

Fig. 3 is an elevational view of the device of the present invention showing the forming fingers in lowered or inoperative position, and also showing the glass tube for the stem and the exhaust tube preparatory to being clamped in position;

Fig. 4 is a view of the forming head of the present invention similar to Fig. 3, showing the forming fingers in elevated or compressing position, and the stem tube and exhaust tube clamping members in engaged position;

Fig. 5 is a vertical sectional view taken substantially on the line 5—5 of Fig. 4;

Fig. 6 is a horizontal sectional or plan view taken substantially on the line 6—6 of Fig. 4;

5 Fig. 7 is a detail view taken substantially on the line 7—7 of Fig. 4;

Fig. 8 is a horizontal sectional view taken substantially on the line 8—8 of Fig. 4;

10 Fig. 9 is a horizontal sectional view taken substantially on the line 9—9 of Fig. 4;

Fig. 10 is a detail section taken substantially on the line 10—10 of Fig. 4;

15 Fig. 11 is a detail view of the spring mounting for the stem tube clamping device;

15 Fig. 12 is a detail view taken substantially on the line 12—12 of Fig. 11;

Fig. 13 is a detail view of the exhaust tube clamp engaging and disengaging mechanism, showing the parts in engaged position;

20 Fig. 14 is a view similar to Fig. 13, showing the parts in disengaged or released position;

25 Fig. 15 is an elevational view, partly in vertical section, showing the wire holding block and glass stem following the forming operation;

Fig. 16 is a transverse sectional view taken substantially on the line 16—16 of Fig. 15;

30 Fig. 17 is a sectional view taken substantially on the line 17—17 of Fig. 15;

Fig. 18 is a sectional view taken substantially on the line 18—18 of Fig. 15;

35 Fig. 19 is a sectional view taken substantially on the line 19—19 of Fig. 15;

Fig. 20 is a vertical sectional view of the wire block taken substantially on the line 20—20 of Fig. 16;

40 Fig. 21 is a vertical sectional view taken substantially on the line 21—21 of Fig. 17;

40 Fig. 22 is a detail view of the slidable pressing finger sleeve;

45 Fig. 23 is an elevational view of a modified form of construction in which the primary or relatively narrow pressing blocks operate slightly in advance of the secondary blocks which approach the stem in a direction perpendicular to that of the primary pressing blocks;

50 Fig. 24 is a plan view of the structure shown in Fig. 23;

Fig. 25 is a vertical section taken substantially on the line 25—25 of Fig. 23;

55 Fig. 26 is a detail plan view of the spring ring interposed between the sliding collars in the form of construction shown in Fig. 23; and

Fig. 27 is a sectional view taken on the line 27—27 of Fig. 26.

60 As shown in Figs. 1 and 2, the stem pressing heads of the present invention are shown operatively mounted upon a revolving table 30 which is adapted to support a plurality of heads on the upper surface adjacent the periphery in such manner as to index or carry the heads to successive heating or operative

stations in carrying out the process of forming and pressing the stems. This operating mechanism is not shown in detail inasmuch as it forms no part of the present invention but illustrates the general method of use. 70

Each head generally designated as 31, is rotatably mounted in a socket provided on the table 30. By suitable driving mechanism, the table 30 is revolved in a step by step or intermittent motion, and also the individual heads 31 are rotated within the sockets. In the typical installation illustrated, the stem tubes and exhaust tubes, as well as the wire holding block, may be mounted in the head at loading and unloading station 32. At station 33 a heating fire is applied to the stem tube during an interval of rest of the revolving table 31, and while the head in this position is rotating. A more intense heat is applied at station 34 to gradually raise the temperature of the tube, and at station 35 extremely hot flames are directed upon the tube, at which point the glass has commenced to collapse and is in a molten state, susceptible to pressing and forming. 80

Also, at this station, the pressing fingers are operated by elevation of the operating rod hereinafter described, and at station 36 the same is subjected to an annealing fire to gradually reduce the temperature after the 90 pressing operation. Upon removal from the machine, the completed stems are placed in a separate annealing machine for further gradual cooling to avoid cracking.

The device of the present invention preferably comprises a main cylindrical support 37 having a lower reduced bore to receive a vertically slidable operating rod 38. The upper end of rod 38 is pivotally connected to a transverse wrist pin 39 vertically movable 100 in slots 40. Wrist pin 39 is connected to and adapted to carry a slidable sleeve member 41 normally adapted to rest in lowered position on a lower collar 42 rigidly secured to the main support 37, and the upper movement 105 of sleeve 41 is limited by an adjustable collar 43 surrounding member 37 and adjustable at different elevations by means of set screws 44. The upper portion of cylinder 37 is adapted to receive a wire holding block 45 positioned in place by means of laterally extending pins 46 which register in corresponding notches on the upper surface of cylinder 37. As a convenience in manufacture, the wire holding block 45 is composed 110 of an upper portion 47 and lower portion 48 secured together by screws 49. The upper block portion 47 is preferably provided with a plurality of diametrically aligned vertical openings to receive and maintain in position 115 a plurality of element supporting or connecting members in the form of wires 50. It will be noted that wires 50 are disposed in the same or substantially the same vertical plane, and are conveniently referred to as the pri- 120

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mary supporting wires. The relative length of these wires is determined by the base of a transverse opening 51 in the upper portion of the member 48. In addition to the wires 50, the present invention provides for a set of secondary supporting wires 52 and a second set 53. It will be understood that any number of wires may be employed, but for convenience in illustration and description, a 10 pair of wires for each set is indicated. The wires 52 and 53 are preferably of considerably greater length than the wires 50, and are adapted to extend through opening in portion 48 to the base of slots 54. After being 15 embedded and sealed in the stem by the pressing operation hereinafter described, the wires 52 and 53 provide auxiliary element supports disposed in planes perpendicular to the plane of the primary wires 50, and transversely 20 adjacent the ends of the row of wires 50. These wires may be employed, therefore, to increased advantage in supporting elements, both in line or plane of support and in positions laterally thereof to afford a more stable 25 and effective element support, and to resist and prevent displacement of the parts as above referred to.

Rigidly mounted adjacent the upper portion of cylindrical support 37 is a collar 55 30 upon which are pivotally mounted the lower ends of diametrically opposed pressing arms 56 and 57. These arms are formed with a pronounced curvature whereby when brought into pressing position with the glass stem, 35 the approach will be substantially in a horizontal direction, and each arm 56 is also provided at its upper extremity with a pressing block 58 of a length equivalent to the linear portion of the stem to be pressed, and of a 40 width less than that occupied by the wires 50. A length of glass tubing 59 is clamped in position as shown in Figs. 3 and 4, and, as hereinafter described, directly above the wire holding block 45, and in position to enclose 45 the upwardly projecting wires in the sealed portion. Thus, when arms 56 and 57 converge in a direction perpendicular to the plane of the main wires 50, the glass stem 50 is pressed as shown in Fig. 9, forcing the molten glass around the wires and providing 55 a tight seal. Simultaneously with this pressing operation, a second pair of arms 60 and 61, correspondingly pivoted to the collar 55, is forced inwardly in opposed relation and in 60 directions perpendicular to the direction of movement of arms 56 and 57, and heads 58. Arms 60 and 61 are each provided with a pressing block 62 having a substantially flat surface adapted to contact with and press the molten glass 59, and thus, at the completion 65 of a pressing operation, the press stem assumes the position shown in Fig. 9, with the main or primary supporting wires sealed in the central portion, and the laterally disposed auxiliary or secondary supporting wires 52

and 53 sealed within transverse end portions. This substantial simultaneous pressing operation by the respective arms and pressing blocks is performed through a plurality of links 63, each having its upward end pivotally connected to one of the pressing arms at a point intermediate the ends thereof, and having the lower end pivoted to the slidable sleeve 41. By this construction and arrangement, when the actuating rod 38 is elevated, the pressing arms and blocks mounted thereon are simultaneously brought into converging pressing relation.

A clamping and self-centering device for the tube 59 is also provided and comprises the following mechanism. Mounted directly below the upper collar 55 and rigidly connected to the cylinder 37 is an upper mounting member 64 having a laterally offset portion 65 upon which is mounted vertically extending posts 66. Clamping fingers 67 and 68 are pivotally mounted adjacent the upper portion of post 66 to swing in a horizontal plane, and a three-point contact for engagement with tube 59 is provided by an inwardly extending portion 69 on finger 67, and inward projections 70 on finger 68, each of the projections 70 being tapered at the ends in accordance with the curved surface of the engaged glass, as shown. Pivotally connected to finger 68 is a toggle link 71, and a second toggle link 72 is pivotally connected to finger 67. These toggle links are pivotally connected together and also to the upper extremity of a tube clamp releasing lever 73 pivotally mounted on the supporting member 64 and provided with an operating knob 74. At the lower extremity, below the pivotal mounting, lever 73 extends within vertical slots 75 of a shell 76, secured to the adjacent side of the cylinder 37, and disposed within shell 76 is a compression spring 77 arranged to bear against lever 73 for normally urging the lever outwardly, and consequently the fingers 67 and 68 with the extensions 69 and 70 in clamping position. The clamp is released by merely moving the knob 74 toward the cylindrical support 37 causing the release of the clamping members in opposite horizontal directions to the dotted line position shown in Fig. 8.

An exhaust tube 78 is provided for exhausting the air or pumping the air from a vacuum tube, for example, and is maintained in clamped position by a pair of horizontally movable and vertically swingable clamping fingers 79 and 80. By reference to Fig. 6, it will be noted that these fingers are likewise arranged to provide a three-point contact on the exhaust tube 78 by means of a block 81 and projection 82 on finger 79, and an inwardly extending projection 83 on finger 80. Fingers 79 and 80 are pivotally mounted both for limited horizontal movement toward and away from each other, and for vertical 125

movement upon a vertically extending pin 84 mounted upon the upper extremity of post 85 for horizontal movement, and by pivotal mounting upon transverse pin 86. The opposite ends of fingers 79 and 80 are offset and spaced apart for disposition upon either side of a connecting link 87, the upper portion of which is provided with a vertical slot to receive a transverse pin 88 which likewise 10 extends through openings in the adjacent ends of fingers 79 and 80. A compression spring 89 is mounted between the end of finger 80 and one end of pin 88, tending normally to urge the ends of fingers 79 and 80 together to 15 the position shown in Fig. 14, whereby they are in releasing or disengaged position.

Engagement or clamping relation of the fingers is effected by a shoulder portion 90 on the connecting link 87 which tends to spread 20 the adjacent ends of fingers 79 and 80, and consequently force the opposite clamping ends into clamping position. Connecting link 87 is pivotally mounted upon the upper extremity of an operating bar 91 vertically 25 slidable in brackets 92 and 93 secured to post 85. Bar 91 is normally urged upwardly by compression spring 94 interposed between bracket 93 and stop 95 mounted on the bar 91. In this position the shoulder portion 30 90 of link 87 is adapted to maintain the adjacent ends of fingers 79 and 80 in spread relation, thus clamping the opposite ends on the exhaust tube 78. Bar 91 may be temporarily locked in lowered position by means of a 35 notch 96 adapted to engage the adjacent portion of member 64 upon a slight shifting inwardly of bar 91 by means of knob 97 to the position shown in Fig. 3, and this operation is also assisted by a lower notch 98 adapted 40 to engage bracket 93 when in the position shown in Fig. 3. During the initial movement of bar 91 in a downward direction, shoulder 90 is disengaged from fingers 79 and 45 80, causing the clamping portions to spread laterally to disengage the exhaust tube 78 through the action of the compression spring 89. As the bar 91 continues in lowering movement, the clamping fingers are elevated to the position shown in Fig. 3 by pivotal 50 movement upon the transverse pin 88, and it will also be understood that in the reverse clamping movement, the fingers are initially lowered to the proper level as shown in Fig. 4, and finally clamped from opposed horizontal directions by means of the engagement 55 of the shoulder portion 90. It will be noted that the entire clamping mechanism for both the stem tube and the exhaust tube is arranged in alignment and mounted at one side 60 of the main body portion of the head. This arrangement affords the least obstruction and interference with the heating flames during the heating and pressing operations, and thus allows for a more uniform application of 65 heat to the stem tube.

A modified structure and operation in connection with the pressing arms is shown in Figs. 23 to 27. By this construction the relatively narrow pressing blocks 58, mounted upon pressing arms 56 and 57, are intended to be brought into pressing relation slightly in advance of the flat surfaced pressing blocks 62, following which blocks 62 continue their pressing movement to the final pressing position. This operation has the advantage of molding and pressing the glass around the primary wires 50 slightly in advance of the molding and sealing of the glass around the auxiliary wire supports 52 and 53, and in acting upon molten glass in a plastic condition, with these pressing operations applied from diametrically opposite directions and perpendicularly to the planes of the wires, a more substantial and durable seal is obtained. In this slightly modified form, the arms 56 and 57 are connected by links 99 to an upper 70 slidable sleeve 100 which carries transverse pin 101 movable in the vertical slots 40. The other pair of arms 60 and 61 are connected by links 102 to a lower slidable sleeve 103. Sleeve 103 carries a transverse pin 104 pivotally connected to the upper extremity of operating rod 38. Interposed between sleeves 100 and 103 is a split spring ring 105 normally adapted to maintain the sleeves spaced a 75 slight distance to obtain the differential pressing operations described. Upon elevation of operating rod 38, upper sleeve 100 contacts with collar 43 which brings the pressing blocks to the positions shown in Fig. 24. Thereafter the elevation of rod 38 continues a slight distance until spring 105 is compressed, in the position shown in Fig. 25, and the pressing blocks are in the final pressing position. It will be understood that when 80 rod 38 is released, the slidable sleeves and the connected links and pressing arms descend by gravity.

The operation of the mechanism has been indicated in conjunction with the foregoing description and construction. The element supporting wires for sealing within the stem are first disposed in the wire holding block 45, which is then placed in the cylinder 37. The glass tube 59 for the stem is then clamped in position by manipulating the knob 74 and the exhaust tube 78 is clamped in position by manipulation of knob 97 attached to the bar 91. Thereafter the head is carried through the desired heating operations for reducing the stem tube 59 to a molten condition suitable for pressing, and in the pressing operation, operating rod 38 is elevated, bringing the pressing arms and pressing blocks into operative position as above described. The construction permits of convenient and rapid operation, while at the same time producing improved results in the formation of stems, as described.

While I have illustrated and described the

preferred form of construction for carrying my invention into effect, this is capable of variation and modification without departing from the spirit of the invention. I, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

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

1. Apparatus of the character described comprising, in combination, means for holding a plurality of main element supporting members in substantial alignment and for holding auxiliary element supporting members in transverse relation to said main supporting members, means for clamping a stem forming tube, and means for pressing said tube to seal said supporting members, said pressing means comprising a pair of pressing members movable in a direction substantially perpendicular to said main supporting members, and a second pair of pressing members movable in a direction substantially perpendicular to said auxiliary supporting members.

2. Apparatus of the character described comprising, in combination, a wire holding block constructed and arranged to position a plurality of main element supporting members in a substantially aligned row, said block also arranged to position auxiliary element supporting members transversely at one end of said row of main supporting members, and means for pressing molten glass to seal said supporting members, said pressing means comprising a pair of compressing blocks movable in converging relation in a direction perpendicular to said row of main supporting members, and a second pressing block movable in a direction substantially perpendicular to the plane of said auxiliary supporting members.

3. Apparatus of the character described comprising, in combination, a wire holding block constructed and arranged to position a plurality of main element supporting members in a substantially aligned row, said block also arranged to position auxiliary element supporting members transversely at one end of said row of main supporting members, and means for pressing molten glass to seal said supporting members, said pressing means comprising a pair of pressing blocks each of less width than the length of the row of main supporting members, and also comprising a pressing block of greater width than the area occupied by said auxiliary supporting members.

4. Apparatus of the character described comprising, in combination, a holding block arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary sup-

porting wires in a plane transverse to said main supporting wires, pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, and a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting wires.

5. Apparatus of the character described comprising, in combination, a holding block arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary supporting wires in a plane transverse to said main supporting wires, pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting wires, and means for operating said pressing blocks simultaneously.

6. Apparatus of the character described comprising, in combination, a holding block arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary supporting wires in a plane transverse to said main supporting wires, a pair of pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting wires, and means for operating said pair of pressing blocks slightly in advance of said last mentioned pressing block.

7. Apparatus of the character described comprising, in combination, a holding block arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary supporting wires in a plane transverse to said main supporting wires, a pair of pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting wires, and clamping means for supporting a tube in a position for engagement by said pressing blocks.

8. Apparatus of the character described comprising, in combination, a holding block arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary supporting wires in a plane transverse to said main supporting wires, pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting wires, means for operating said pressing blocks simultaneously, and clamping means

for supporting a tube in a position for engagement by said pressing blocks.

9. Apparatus of the character described comprising, in combination, a holding block 5 arranged to hold a plurality of main supporting wires in substantially the same plane, said block also arranged to hold auxiliary supporting wires in a plane transverse to said main supporting wires, a pair of pressing blocks adapted to compress glass in a direction perpendicular to the plane of said main supporting wires, a pressing block adapted to compress glass in a direction perpendicular to the plane of said auxiliary supporting 10 wires, means for operating said pair of compressing blocks slightly in advance of said last mentioned pressing block, and clamping means for supporting a tube in a position for engagement by said pressing blocks.

15 20. 10. A stem pressing head comprising a supporting member, a collar secured to said supporting member, a block for holding element supports, a clamping member adapted to position a stem tube adjacent said block with 25 a portion surrounding said element supports, a pair of pressing members pivotally mounted upon said collar and provided with main pressing blocks, a second pair of pressing members pivotally mounted upon said collar 30 and provided with auxiliary pressing blocks arranged to laterally overlie said main pressing blocks, and means for simultaneously moving said pressing members into operative position to engage said stem tube.

35 35. 11. A stem pressing head comprising a supporting member, a collar secured to said supporting member, a block for holding element supports, a clamping member adapted to position a stem tube adjacent said block with 40 a portion surrounding said element supports, a pair of pressing members pivotally mounted upon said collar and provided with main pressing blocks, a second pair of pressing members pivotally mounted upon said collar 45 and provided with auxiliary pressing blocks arranged to laterally overlie said main pressing blocks, a sleeve member slidably mounted upon said supporting member, link members connecting said sleeve member and 50 said pressing members, and means for operating said sleeve member to simultaneously move said pressing members into operative position to engage said stem tube.

55 12. A stem pressing head comprising a supporting member, a collar secured to said supporting member, a block for holding element supports, a clamping member adapted to position a stem tube adjacent said block with a portion surrounding said element supports, a pair of pressing members pivotally mounted upon said collar and provided with main pressing blocks, a second pair of pressing members pivotally mounted upon said collar and provided with auxiliary pressing 60 blocks arranged to laterally overlie said main

pressing blocks, and means for moving said main pressing blocks into operative engagement with said stem tube slightly in advance of the engagement of said auxiliary pressing blocks.

In testimony whereof I have signed my name to this specification.

GEORGE D. McCABE.

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