March 14, 1933. W. DALHEIMER 1,901,087

APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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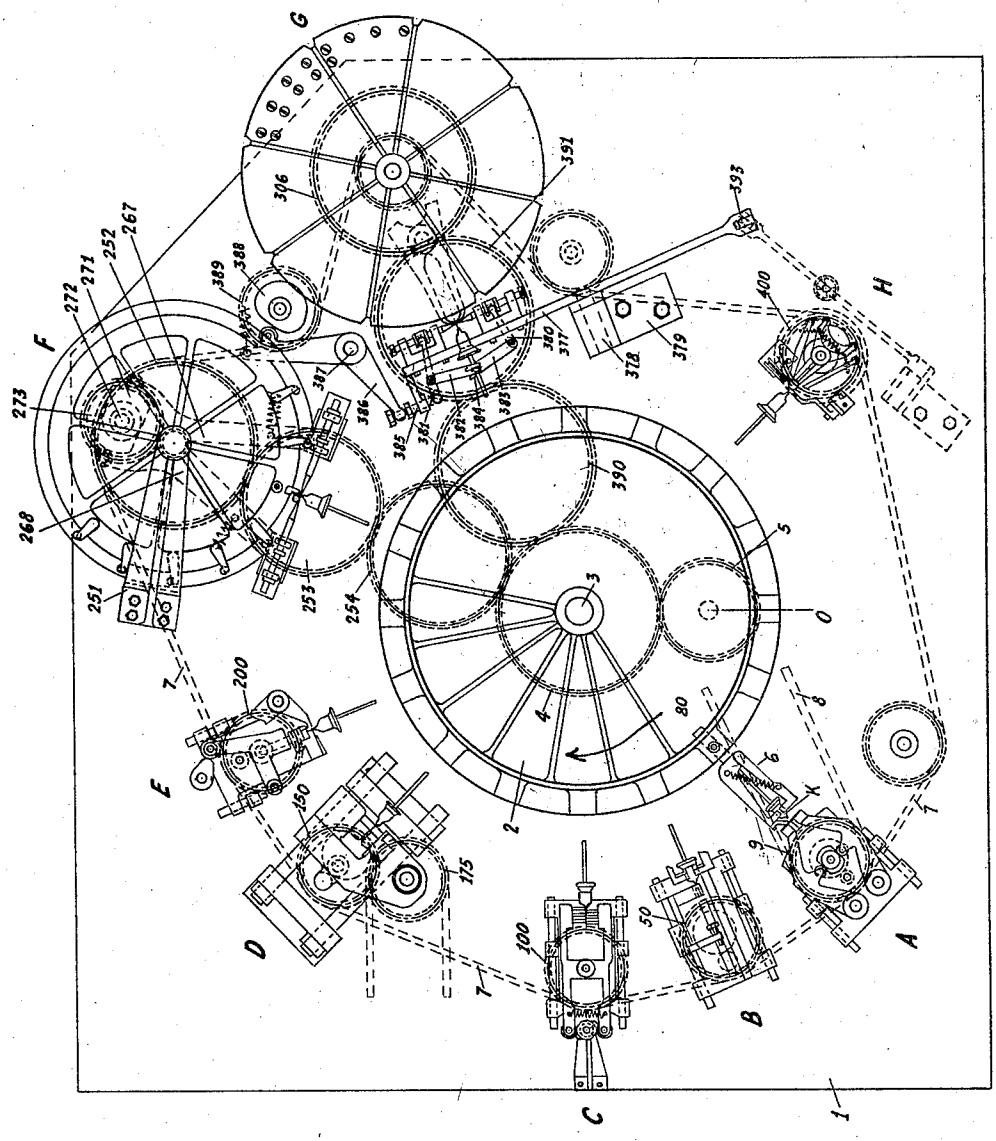


Fig. 1

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March 14, 1933. W. DALHEIMER 1,901,087

APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 2

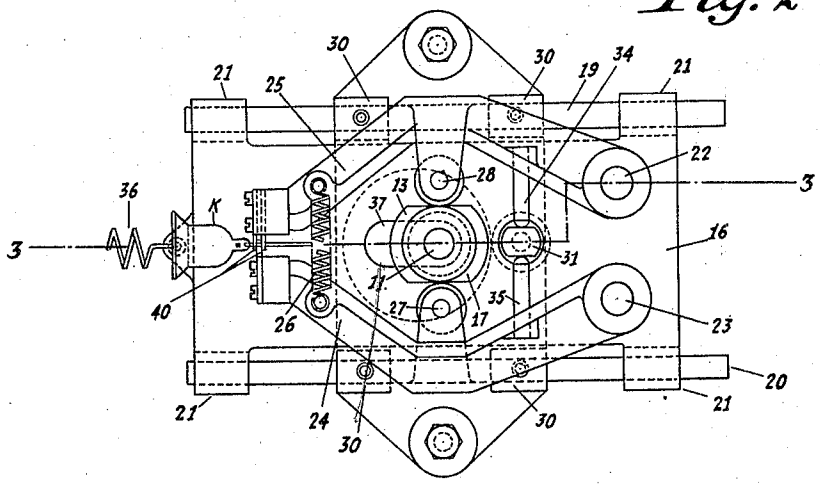
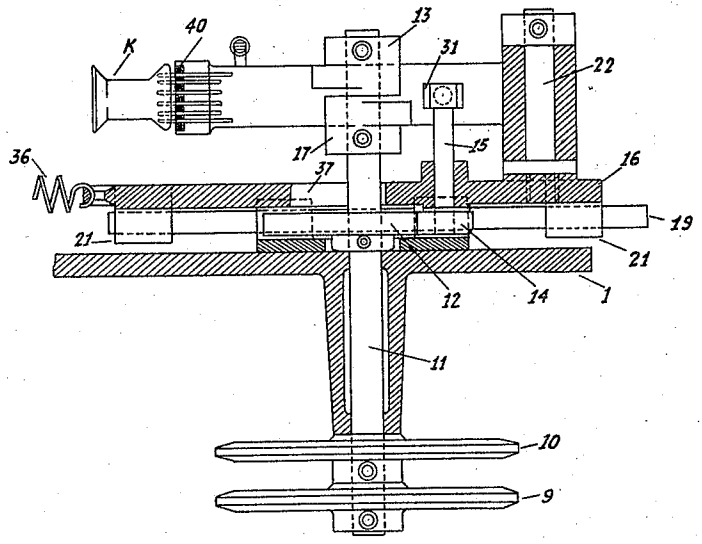


Fig. 3



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 4

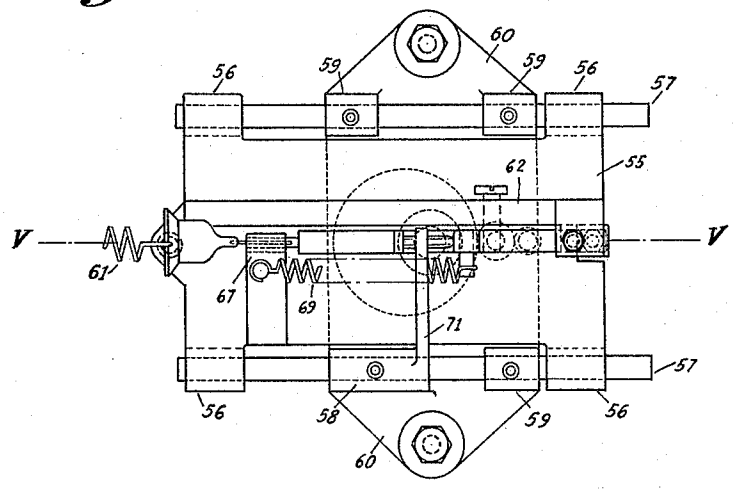
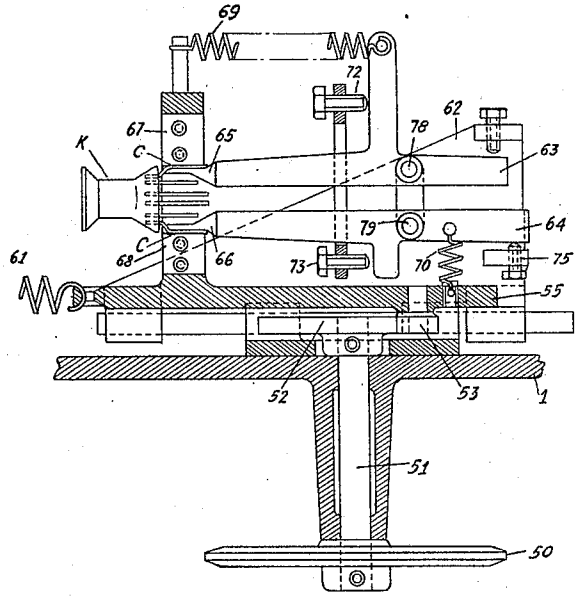


Fig. 5



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 6

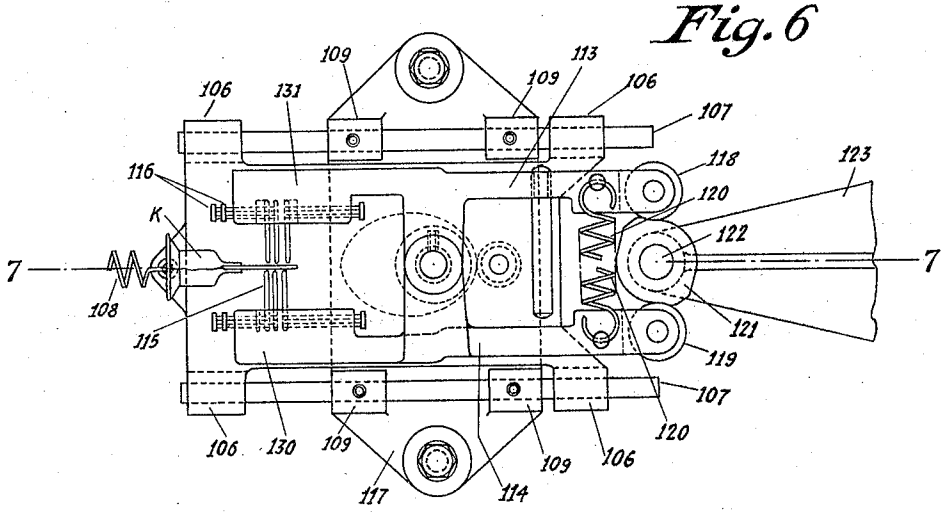
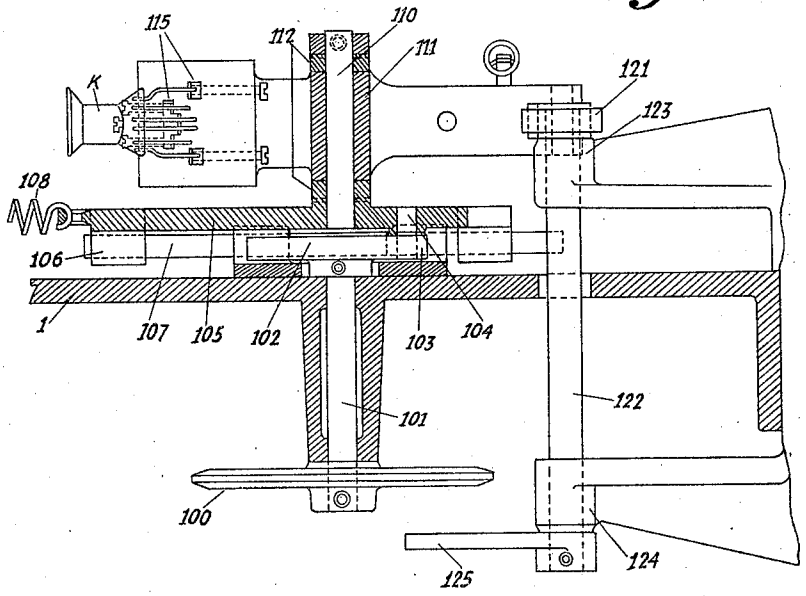


Fig. 7



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March 14, 1933. W. DALHEIMER 1,901,087

APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 9

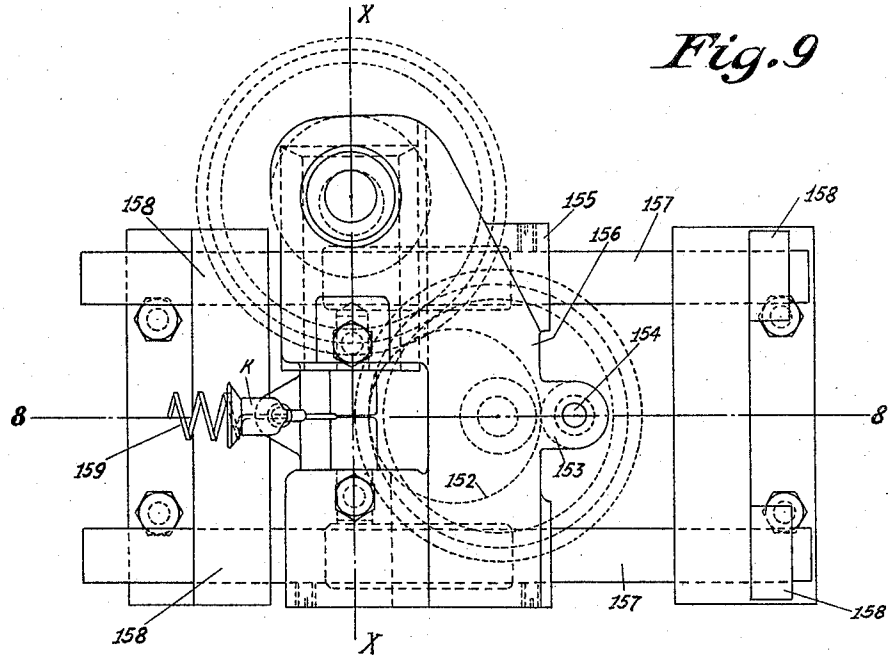
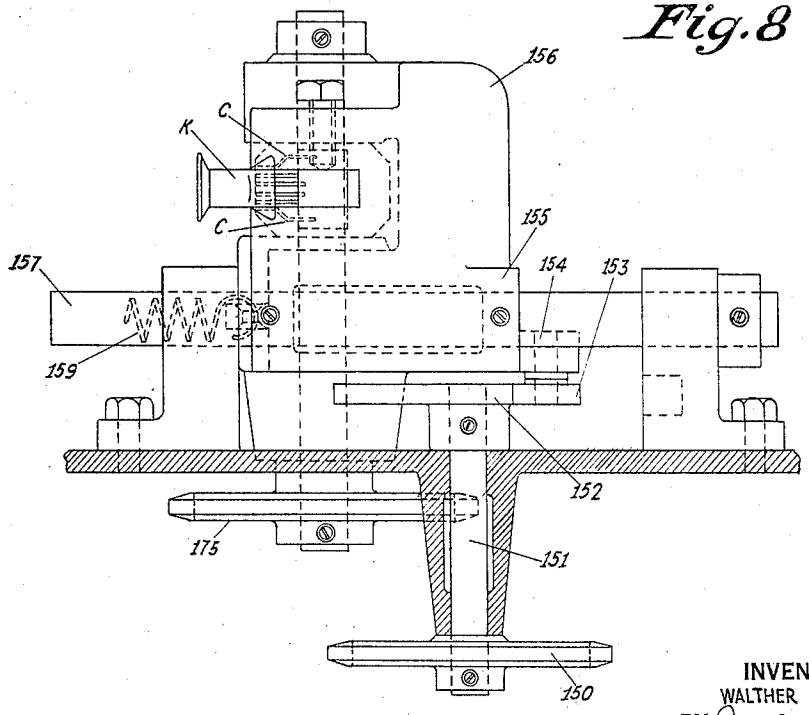


Fig. 8



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 13

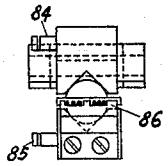


Fig. 11

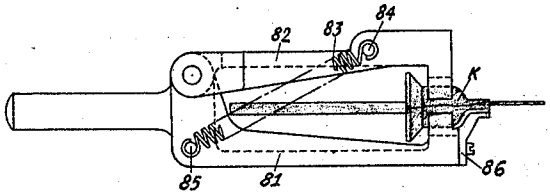


Fig. 12

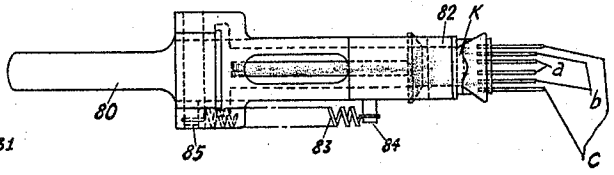


Fig. 19

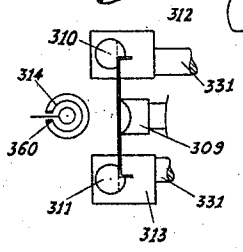


Fig. 20

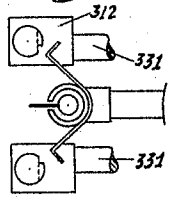


Fig. 10

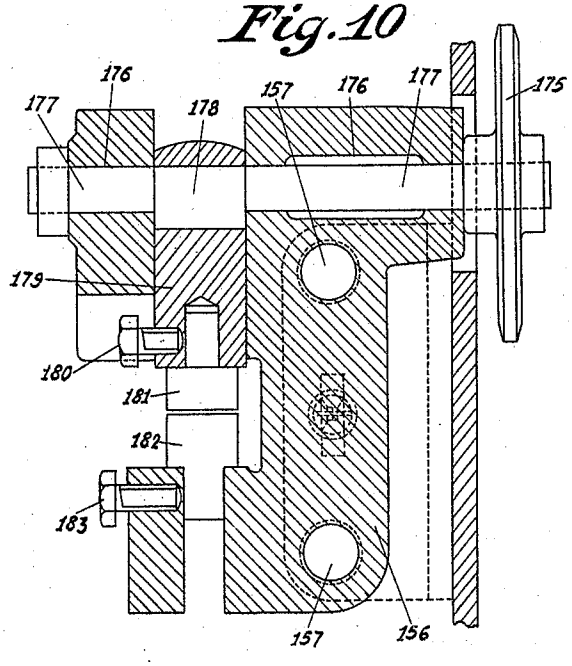
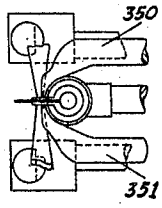


Fig. 21



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 15

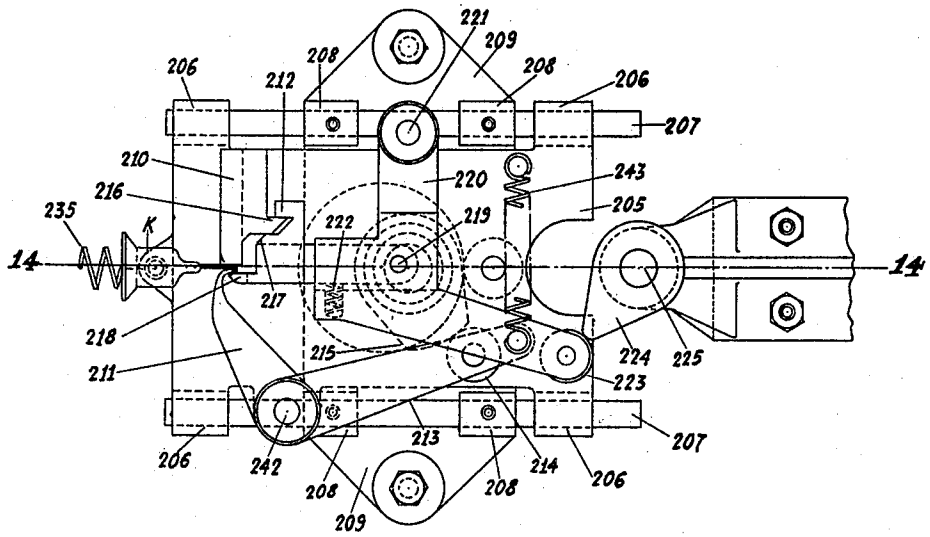
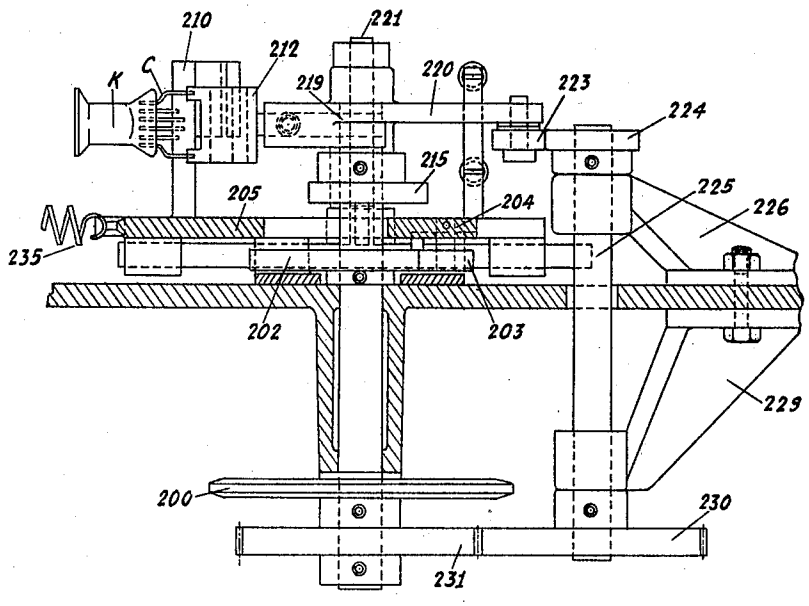


Fig. 14



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig.16

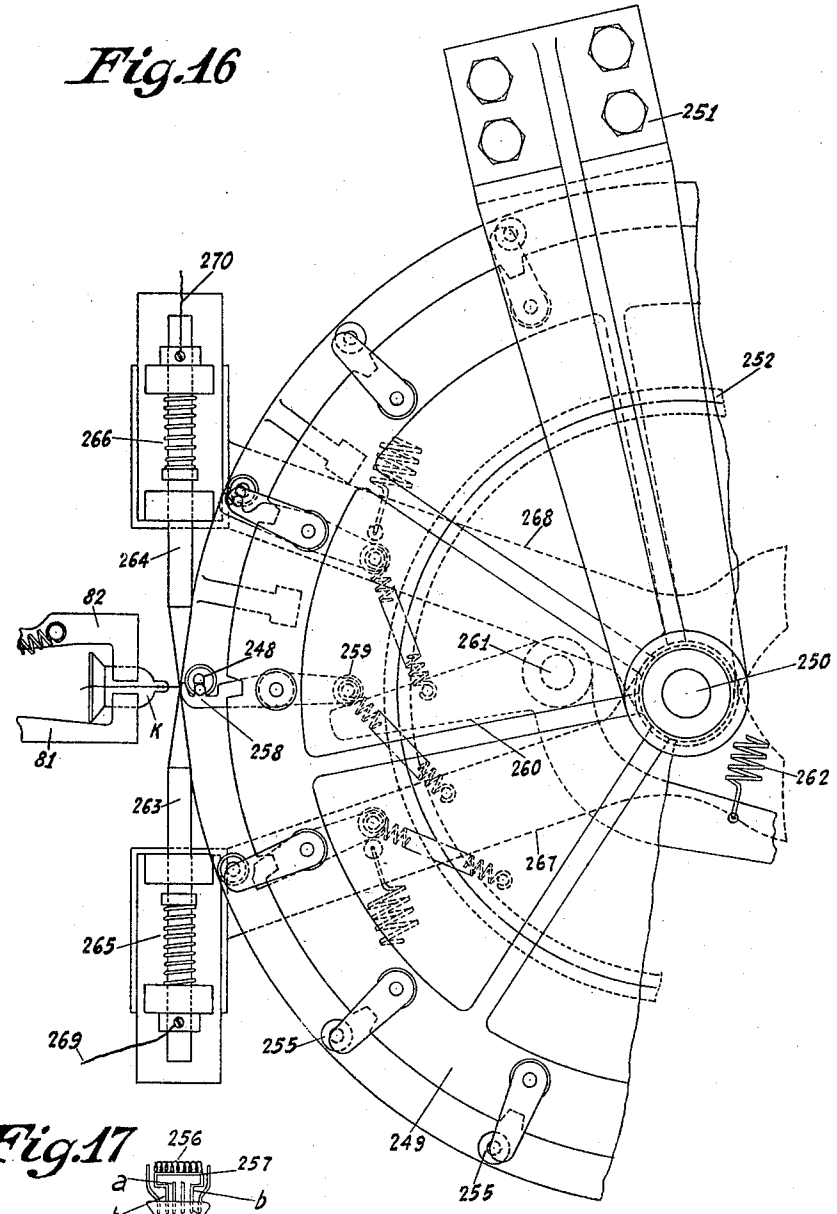
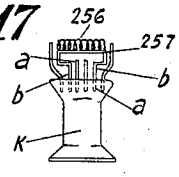


Fig.17



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 22

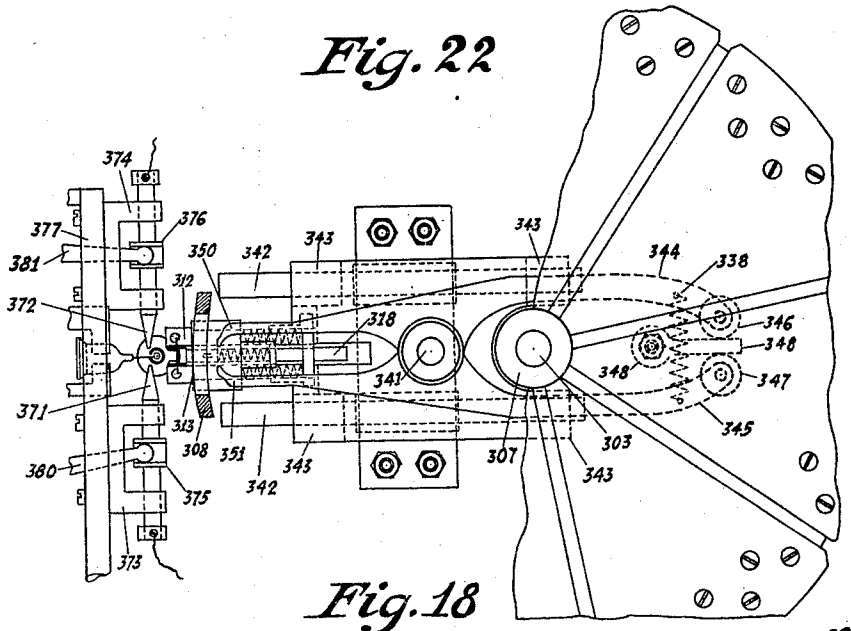
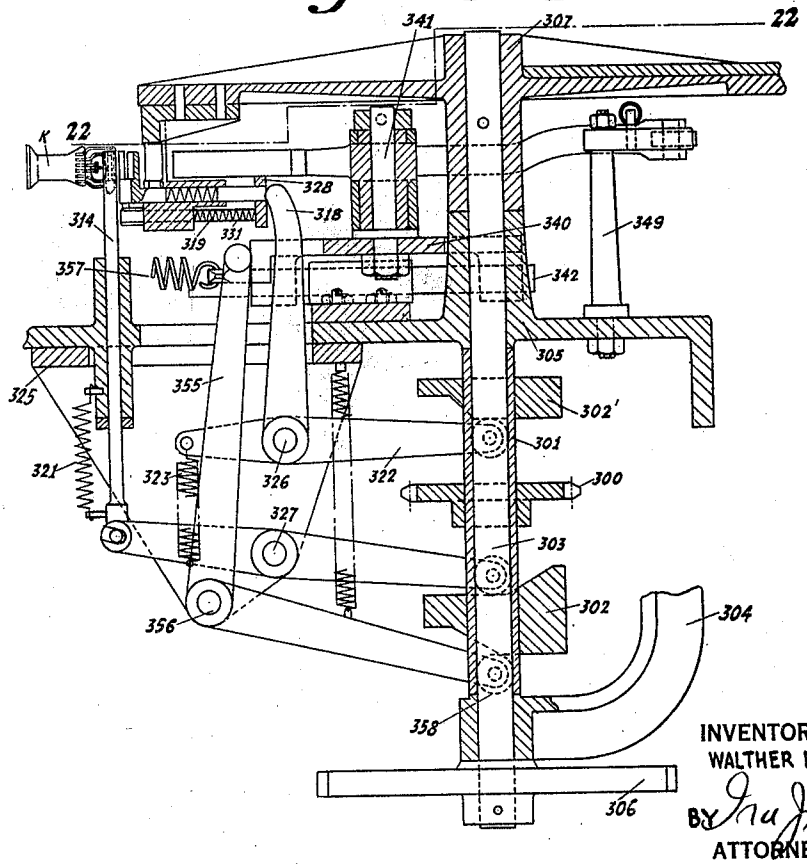


Fig. 18



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APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

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Fig. 23

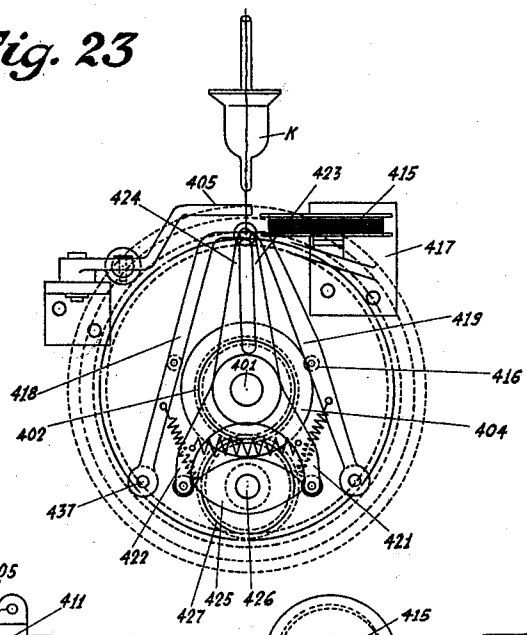


Fig 25

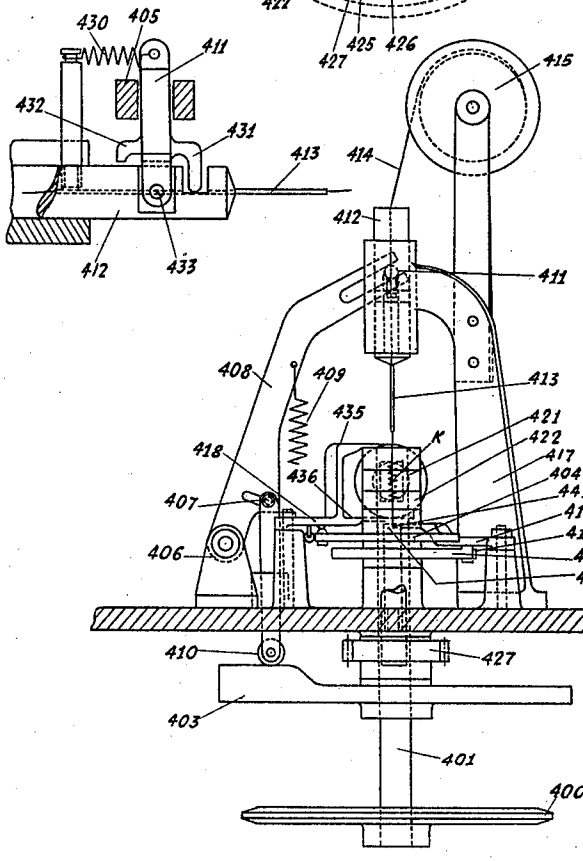


Fig. 24

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Patented Mar. 14, 1933 1,901,087

UNITED STATES PATENT OFFICE

WALTHER DALHEIMER, OF EINDHOVEN, NETHERLANDS, ASSIGNOR TO RADIO CORPORATION OF AMERICA, A CORPORATION OF DELAWARE

APPARATUS FOR MECHANICALLY MOUNTING ELECTRODES OF THERMIONIC TUBES

Application filed October 26, 1927, Serial No. 228,791, and in the Netherlands August 12, 1926.

This invention relates to apparatus for mechanically mounting the various electrodes on the supporting and leading-in wires of the glass stems for thermionic tubes. The term "stem for thermionic tubes" is to be understood hereinafter to mean those members of discharge tubes that serve to hold the various leading-in and supporting wires together prior to their being sealed in the bulb to form therewith a single unit.

The apparatus according to the invention comprises mechanisms for dressing and shaping the supporting and leading-in wires. mechanisms for mounting the various electrodes on the said wires and means by which the glass stem is successively brought into operative relation to the said mechanisms.

According to the invention an intermittently rotating table has mounted on its carriers or chucks for the glass stems and the various mechanisms are so arranged as to be adapted to move into and out of the path of travel of the said carriers. For this purpose the mechanisms for dressing and shaping the supporting and leading-in wires are mounted on slides adapted to move radially to the rotary table.

After the supporting and leading-in wires are sealed in the stem press and, the unfinished stem is inserted in the stem carriers or chucks of the machine, the leading-in and supporting wires will not be exactly normal to the press in the majority of cases. In connection with the further manipulation and shaping of the said wires it is important that they should constantly occupy the same position relatively to the mechanisms.

According to the invention a combing mechanism for dressing or positioning the supporting and leading-wires is provided, said mechanism comprising a toothed member or comb. There may also be provided a head having two toothed jaws adapted to be closed around the supporting and leading-in wires and to be then moved away from the chuck along the centre line of the stem. In either case the supporting and leading-in wires will be so dressed or positioned as to be parallel to each other whilst being normal to the press.

Generally a discharge tube comprises two leading-in wires for the incandescent cathode and one leading-in wire with a supporting wire for the anode. In the case of a triode which in addition to the incandescent cathode and the anode comprises a grid there will also be provided a supporting and leading-in wire for the grid. For each additional electrode the number of wires will be further increased. For the attachment of the incandenscent cathode the leading-in wires are usually flattened and doubled at their ends to form hooks. The filament is then secured to the leading-in wires by closing the hooks on the ends of the filament. Furthermore the outermost wires in the press should be slightly bent out so as to permit of the other electrodes, such as the grid and the plate or anode, being mounted. To shape the said wires the shaping mechanism is provided which according to the invention comprises a bending and flattening device.

According to the invention the wires may be shaped by a sliding head provided with jaws which are opened between the wires of the stem and which are so profiled that when they are in closed position they bend the wire into the desired shape. According to the invention the end of a supporting or leading-in wire which is to be doubled, into a hook may be clamped between a fixed stop and a tongue-shaped jaw on the sliding head, after which the end of the wire may be bent around the said tongue by the jaw.

After the supporting and leading-in wires are shaped and cut to proper lengths the glass stem comes into operative relation to a device for mounting the grid. According to the invention this device comprises a revolving magazine having carriers for the separate grids and so arranged that the path of travel of the carriers of the said magazine is tangent to the path of travel of the carriers or stem chucks on the rotary table. By moving the revolving magazine intermittently and in step with the rotary table, a filled carrier will come into operative relation to an unmounted stem with each step of the rotary table in its intermittent revolution. The grid which is inserted in the magazine by

the operator is preferably provided with a supporting wire which in the operative position of the magazine can be secured to the supporting wires of the stem. According to the invention, for this purpose a welding device is arranged at the tangent point of the two paths and on the common tangent line. The said welding device may comprise two studs or electrodes moving along the tangent line but in opposite directions and arranged on each side of the welding point.

The mechanism according to the invention for mounting the plate or anode comprises a revolving magazine having carriers for the separate component members of the said anode and so arranged that the path of travel of its carriers is tangent to the path of travel of the carriers or chucks on the rotary table.

For the manufacture of the plate or anode cylindrical plates may be used as well as flat plates. The finished plates may then be inserted in the magazine, but the anode shaping operation may also be deferred to the moment when the anode is secured to the supporting and leading-in wires. If, for example, cylindrical anodes are mounted on the stem, a cylindrical mandrel may be arranged so as to reciprocate at the tangent point of the paths of the revolving magazine and the rotary table. In case the grid is already mounted on the stem, the said mandrel must be provided with a central bore and a longitudinal slit. In order that the cylindrical anode may be bent each magazine comprises a clamping device for so holding the flat anode plate that the latter is parallel to the axis of the mandrel. When such a flat plate is moved into the operative position it is forced by a member against the mandrel, and bent by the jaws of a head around the said mandrel into the shape of a cylinder, after which the plate is secured to the leading-in wires of the footstep. For this purpose a welding device may be provided, said device being mounted in the common tangent lines in the tangent point of the two paths. According to one embodiment of the invention the said device is mounted on a movable lever so as to be adapted to be moved as a whole into and out of operative relation to the stem.

Finally a mechanism is provided for mounting the filament or incandescent cathode on the glass. For this purpose, a member is mounted so as to be reciprocable. When a stem is in operative relation to the said filament mounting device, the said member moves along the axis of the grid mounted on the stem. As a rule it is preferable that of all the electrodes the filament or cathode should be mounted last because it is usually a very thin and delicate wire and is surrounded by the grid and the anode.

In one embodiment of the invention the grids and the anodes are mounted first of all, after which a hollow needle in which a filament wire is inserted is moved along to the axis of the grid. The needle moves toward and away from a gripping member which grips the wire carried by the said needle and moves into the doubled ends of the leading-in wires of the stem, after which the said ends are closed on the filament wire by clamping jaws thereby mounting a length of filament wire on the leading-in wires. Subsequently the mounted filaments are cut off on each side of the leading-in wires.

In the accompanying drawings an embodiment of the invention is shown. In the said drawings:

Figure 1 is a plan of an apparatus in which the glass stems travel successively through various positions, the supporting and leading-in wires being thus successively properly positioned and provided with various electrodes.

Figures 2 and 3 show a plan and a sectional view respectively of a mechanism in which the supporting and leading-in wires are combed.

Figures 4 and 5 show a plan and a sectional view respectively of a mechanism that bends the outermost supporting wires of the stem.

Figures 6 and 7 show a plan and a sectional view respectively of the mechanism that cuts the supporting and leading-in wires to proper lengths.

Figures 8, 9 and 10 show mechanisms in which the outermost leading-in wires are flattened at their ends.

Figures 11, 12 and 13 show the three projections of the carrier or chuck for the stem.

Figures 14 and 15 show a sectional view and a plan respectively of a mechanism for doubling the flattened ends of the outermost leading-in wires.

Figure 16 shows a plan of a mechanism in which the grid is secured on the stem.

Figure 17 shows the glass stem after the grid's attachment to the supporting wire.

Figures 18, 19, 20, 21 and 22 show the mechanism in which the plate-shaped anode is secured to the stem.

Figures 23, 24 and 25 show a mechanism by which the filament is attached to the leading-in wires.

Before entering into the details of the various component members the operation of the apparatus will be briefly set forth. A frame 1 has mounted on it, in addition to a rotary table 2, a number of mechanisms with which the stem is successively brought into operative relation. For this purpose the rotary table 2 has in its rim radial holes or pockets each of which holds a stud 80 (Figure 12) to which the carrier or chuck for the stem is secured. The rotary table is fast on a vertical shaft 3 and is rotated step by step and inter-

mittently by a gear wheel 5 which engages a gear wheel fast on the shaft 3.

The apparatus herein described serves to mount on a stem for a thermionic tube the various electrodes, such as a grid, the plate or anode and the filamentary cathode. For this purpose the stem is placed by hand at position O (Figure 1) in one of the carriers or stem chucks on the rotary table. By reason of the intermittent or step by step motion of the table 2 the stem carrier will successively occupy the positions A, B, C, D, E, F, G, H and the glass stem is successively subjected to various operations as follows: In position A the supporting and leading-in wires of the stem are combed and placed parallel, in position B the two outermost leading in wires (the wires *c*, Figures 5 and 12) are bent, in position C the supporting and leading-in wires are cut to proper lengths, in position D leading-in wires *c* are flattened at their extreme ends, in position E these ends are doubled or bent into hooks, in position F the grid is secured to the wires *b* (Figures 12 and 17), in position G the plate-shaped anode is attached to the wires *a* and finally in position H the filamentary cathode is secured as a wire to the two outermost leading-in wires. Each of the said mechanisms will be more fully described hereinafter.

The combing operation. (Figures 2 and 3)

After the operator has inserted the glass stem in a stem carrier the rotary table 2 moves the said carrier into a position where the stem can be operated upon by the mechanism A.

The stem carrier itself comprises a stud 80 having secured to it a fixed jaw 81 (Figures 11, 12 and 13) which constitutes with the cooperating movable jaw 82 a chuck for the stem. The two jaws are V-shaped and are forced together by a spring 83 secured to the pins 84, 85. The fixed jaw 81 has secured to it a housing 86 which serves to support the projecting ends of the supporting and leading-in wires of the stem held in the chuck.

The mechanism A which is shown in Figures 2 and 3 is operated by a chain wheel 9 fast on a shaft 11 which is journalled in the frame 1. In addition to the chain wheel 9 the said shaft has secured to it a chain wheel 10 and cams 12, 13 and 17. The shaft is rotated by the chain wheel 9 and a chain 8 and transmits this rotation via the chain wheel 10 and a chain 7 to the various chain wheels for the various mechanisms. (Figure 1). On rotation of the shaft 11, the cam 12 engages a roller 14 on a spindle 15 mounted in a slide 16. The slide 16 is adapted to slide by means of sleeves 21 on rods 19 and 20 rigidly mounted in bosses 30. As a result of this mechanism the rotation of the shaft 11 causes the slide 16 to be reciprocated. For this purpose the slide has secured to it a spring 36 which ensures that the roller 14 is in continuous engagement with the cam 12.

In addition the slide 16 has pivoted to it by means of fixed pins 22 and 23 two arms 24 and 25 provided with rollers 27 and 28 which are forced by a spring 26 against the cams 13 and 17 respectively. Combing jaws 40 secured to the ends of the arms 25 and 24, have a number of slits to receive the leading-in wires of the glass stem when the said arms are in closed position. The arms have on them studs 35, 34 which in the extreme closed position of the arms engage a cam 31 mounted on the spindle 15. The operation of the mechanism is as follows. At the moment when the glass stem is moved by the table 2 into operative relation to the mechanism, the arms 25 and 24 are in their rearmost position. By reason of the rotation of the shaft 11, the slide 16 will move forwardly and the cams 13 and 17 will consequently be caused to occupy such a position that the combing jaws of the arms 24 and 25 close upon the supporting and leading-in wires of the glass stem. In order to permit of the slide 16 being reciprocated a slot 37 is provided for the shaft 11. When the supporting and leading-in wires are enclosed by the jaws 40, the mechanism occupies the position shown in Figure 2. On the shaft 11 continuing its rotation the cam 12 will force away the roller 14 so that the slide with the arms 24 and 25 will be moved away from the stem thereby combing out and straightening the wires of the stem. This movement will cause the roller 27 and 28 to ride off the cams 13 and 17 so that the arms 25 and 24 will tend to come together and thus injure the supporting and leading-in wires of the glass stem but the studs 34 and 35 mounted on the arms 24 and 25 encounter the stop 31, and any further closing movement of the combing jaws is prevented. When the arms fall back to their rearmost position they are opened again whereupon the stem is released and moves to the next position.

Shaping the outermost leading-in wires of the glass stem (Figures 4 and 5)

The wire shaping mechanism B which serves to shape the outermost leading-in wires to leave room for attachment of the grid and the plate-shaped anode to the wires destined for them respectively, is operated by a chain wheel 50 which is continuously rotated by a chain 7 (Figure 1). The chain wheel 50 is fast on a shaft 51 which is journalled in the frame 1, and which is provided with a cam 52 that reciprocates a roller 53 secured to a slide 55 against the action of a spring 61. The slide 55 by means of sleeves 56 slides on rods 57 which are rigidly connected by means of bosses 58 and 59 to a housing 60 secured to the frame 1. In addition

the slide 55 is provided with fixed stops 67 and 68 and with a housing 62 to which are pivoted levers 63 and 64 in points 78 and 79. Said levers are provided with jaws 65 and 66 which during the slide's forward motion slide between the wires of the stem. During their forward movement they engage stops 72 and 73 rigidly secured to the boss 58, and thus the levers are rocked so that they force the wires *c* of the glass stem outwardly against the stops 67 and 68. The slide 55 then moves backwards, whereupon the levers 63 and 64 fall out of engagement with the stops 72 and 73 and then are forced by springs 69 and 70 against stops 74 and 75 so that they are prevented from moving inwardly and thus from impairing the innermost support. After the slide has come into its most retracted position the glass stem travels to position C.

Cutting the supporting and leading-in wires of the glass stem. (Figures 6 and 7)

The wire trimming mechanism C is operated by a chain wheel 100 which is continuously rotated by the chain 7 similarly to the other mechanisms. The chain wheel 100 is fast on a shaft 101 mounted in the frame 1 and drives on a cam 102 mounted on the said shaft. A roller 103 on a spindle 104 mounted in a slide 105 is forced by a spring 108 against the cam 102. The slide 105 is adapted by means of sleeves 106 to slide on rods 107 rigidly mounted in bosses 109 secured to a housing 117. In addition the slide 105 is provided with a pivot 110 on which heads 113 and 114 are adapted to revolve by means of sleeves 111 and 112. The said heads are provided with jaws 130 and 131 to which cutters 115 can be fixed by means of bolts 116. In addition the heads are provided with rollers 118 and 119 which ride on a cam 121 mounted on a shaft 122. This shaft which is journalled in brackets 123 and 124 has, in addition, secured to it a lever 125 which in a manner not shown can be actuated periodically, the rollers 118 and 119 being thus moved against the action of a spring 120 which will result in jaws 130 and 131 being opened and closed. By mounting the cutters 115 at the proper height, the supporting and leading-in wires may be cut to proper lengths. This cutting will be done in the most advanced position of the slide 105 (Figures 6 and 7), and its most retracted position will leave sufficient room for the stem to move to the next position D.

Flattening the trimmed leading-in wires of the stem. (Figures 8, 9 and 10).

The wire flattening mechanism D is operated by a chain wheel 150 which is continuously rotated by the chain 7 (Fig. 1). Said chain wheel is fast on a shaft 151 journalled in the table 1 and drives a cam 152. A roller 143 on a spindle 154 on a slide 156 follows the movement of the said cam against the action of a spring 159. The slide 156 is adapted by means of sleeves 155 to slide on rods 157 which in their turn are rigidly secured to bosses 158. As shown in Figure 10 the slide 156 comprises a base having a bearing 176 for a shaft 177, which is turned in the middle to form an eccentric 178 for actuating a block 179 to which is secured a movable punch 181 by a bolt 180. Opposite the movable punch 181 is a fixed punch 182 rigidly secured by a bolt 183 to the slide 156. The shaft 177 is rotated by a chain wheel 175 which is rotated in a manner not shown. The punches 181 and 182 may be so constructed that on approaching each other they flatten only the outermost leading-in wires of the glass stem. After the flattening operation the slide 156 is retracted by the cam 152 and the glass stem can travel to the next position E.

Bending the flattened outermost leading-in wires into hooks. (Figures 14 and 15)

The hook bending mechanism E is operated by a chain wheel 200 which is rotated by the chain 7 and which is fast on a shaft 201 journalled in the table and having secured to it a gear wheel 231 and cams 202 and 215. A roller 203 which by means of a spindle 204 is secured to a slide 205 follows the movements of the cam 202 against the action of a spring 235. The slide 205 is adapted by means of sleeves 206 to slide on rods 207, which are secured in bosses 208 on a housing 209. The slide 205 has fixed to it a stop 210 and in addition it has a lever 211 pivoted to it by means of a pin 242. The lever 211 is provided with a tongue shaped end and is operated by a lever 213 which by means of a roller 214 rides on the cam 215. By reason of the rotation of the said cam the lever 213 is moved against the action of a spring 243 and the tongue shaped end of the lever 211 will thus move toward and away from the stop 210. In addition the slide 205 has mounted on it a lever 220 which swings on a stud 221 and is provided with a roller 223 that rides on a cam 224. This cam is fast on a shaft 225 which is journalled in brackets 226 and 229 and is rotated by a pinion 230 engaging a gear wheel 231. The lever 220 has pivoted to it by means of a stud 219 a member 212 provided with a sliding surface 217 and with a lug 218. It is forced by a spring 222 against a lug 216 of the stop 210. The mechanism operates as follows:

After the glass stem K is carried by the rotary table 2 into the position E, the slide 205 slides forward and the flattened ends of the leading-in wire *c* will be forced by the tongue-shaped lever 211 against the stop 210. At this moment the cam 224 occupies such a position as to permit the roller 223 to approach as closely as possible to the centre line

of the shaft 225. The member 212 will consequently occupy its most retracted position in which its sliding surface 217 is forced by the spring 222 against the lug 216. In this position the projecting cam 218 will consequently be to the right of the leading-in wire of the glass stem K. As the cam 224 continues its rotary motion the roller 223 will recede from the centre line of the shaft 225 and the member 212 will thus be forced in the direction of the glass stem with the result that the sliding surface 217 follows the profile of the lug 216 so that the cam 218 receives such a movement that the flattened end of the leading-in wire *c* is doubled around the tongue shaped end of the lever 211 whereupon the member 212 first returns and then the tongue shaped end of the lever 211 will move out of the hook-shaped end of the hook *c*, whereupon the slide 205 moves into its rearmost position so as to permit the glass to move to the next position F.

Mounting the grid. (*Figures 16 and 17*)

The grid mounting mechanism F comprises a rotatable magazine 249 which rotates on a shaft 250 and by means of gear wheels 252, 253 and 254 receives an intermittent rotation corresponding to that of the table 2. (Figure 1.) The rotatable magazine 249 comprises carriers 255 in which the grids are held. Said carriers comprise a fixed jaw 248 and a movable jaw 258 between which the grid is held. As shown in Figure 17 the grid 256 is provided with a supporting wire 257 which at both ends is bent twice at right angles, said ends being attached to the wires *b* of the stem. The grid with the supporting wires is so inserted in the carriers 255 that in the operative position of the magazine the ends of the supporting wire 257 are precisely in proper relation to the supporting wires *b*. In this position attachment can be effected by a welding device which comprises welding electrodes 263 and 264 resiliently mounted on brackets 265 and 266. The electrodes can be connected to an electric circuit by leads 269 and 270. The brackets 265 and 266 are mounted on levers 267 and 268 adapted to be actuated by a cam 271 (Figure 1) fast on a shaft 272 which is rotated by means of a chain wheel 273 and the chain 7. In addition a bell crank 260 (Figure 16) is provided which is pivoted to a member 261 mounted in the frame 1, and which is actuated in a manner not shown. This bell crank is so mounted that during its movement it engages a roller 259, mounted on the jaw 258, when the latter is in the operative position. This movement, which takes place after the supporting wire of the grid is welded to the wires *b*, will result in the jaw being moved outwardly to such an extent as to allow for the movement of the glass stem with the grid mounted on it to the next position G.

Mounting the plate anode. (*Figures 18, 19, 20, 21 and 22*)

The plate mounting mechanism G is provided with a rotatable magazine 307 which has secured to it carriers 308 having movable members 309, 312 and 313 (Fig. 19) which are so shaped as to be adapted to clamp a flat anode plate. This plate which is to be bent cylindrically, is at its two ends doubled at right angles so as to be secured by means of these parts to the wires *a* of the glass stem. For this purpose the members 312 and 313 are provided with studs 310 and 311 which are milled to have an edge, the arrangement being such that the flat anode plate is exactly clamped between the said two studs and the member 309.

In the operative position of the rotatable magazine 307 relatively to the rotary table 2, is a vertically moving hollow mandrel 314 which is guided by a sleeve mounted on the frame 1 and which is fixed to a lever 320 pivoted in 327 to a housing 325 secured to the frame 1. The said lever has a roller riding on a rotary cam 302 which is keyed to a sleeve 301. This sleeve which is adapted to revolve on a shaft 303 is actuated by a chain wheel 300 operated by the chain 7 (Figure 1). In addition the sleeve 301 (Figure 18) has secured to it a cam 302′ on which rides the roller of a bell crank 322. This bell crank which is pivoted in 326 to the housing 325 moves against the action of a spring 323 and its end 318 bears on a plate 328 in which studs 330 and 331 are rigidly mounted. The studs 331 are directly connected to the members 312 and 313 whereas the stud 330 bears on a spring 329 which in its turn presses against the member 309. When the end 318 of the bell crank moves to the left (Figure 18) the stud 331 will move to the left against the action of a spring 319. At the same time the spring 329 will be compressed by the stud 330 and thus force the member 309 against the plate-shaped anode (Figure 19). This movement will be continued until the plate-shaped anode engages the mandrel 314 after which the said plate is bent around the mandrel by the hollow member 309 (Figure 20). Any further movement of the member 309 is opposed by the mandrel and the spring 329 is compressed while the members 312 and 313 proceed. By reason of this movement they are carried out of engagement with the plate to such an extent that when the latter is being completely bent around the mandrel they will not be in its way.

The bending operation is effected by jaws 350 and 351 pivoted on a spindle 341 which is mounted on a slide 340 adapted by means of sleeves 343 to slide on rods 342 rigidly attached to the frame 1. The jaws 350 and 351 form part of heads 344 and 345 which are provided with rollers 346 and 347 and which

are pulled towards each other by means of a spring 338. Thus the rollers 346 and 347 are forced against a stationary cam 348 which is secured to a column 349 fixed to the frame 1. The slide 340 has in contact with it a bell crank 355 which is pivoted in 356 to the housing 325 and which is provided at its other end with a roller 358 riding on the cam 302. By reason of the movement of the bell crank the slide 340 slides backwards and forwards, the spring 357 keeping the slide in contact with the end of lever 355.

When the plate-shaped anode is bent as shown in Figure 20 the slide 340 is moved towards the left. By reason of this motion the rollers 346 and 347 ride on the cam 348 which ensures that the jaws 350 and 351 slide around the mandrel 314 and guide the plate in such a manner that it takes a complete cylindrical shape and its doubled end is caused to bear on the wires *a* of the glass stem. In this position are provided welding pins 371 and 372 which by means of brackets 373 and 374 are secured to the lever 377 and which are actuated by means of a guide 375 and 376 and levers 380 and 381. The lever 381 is operated by a rod 385 (Figure 1) and imparts its movement to the lever 380 by means of levers 382 and 383 coupled in 384. The lever 377 is pivoted by means of a pin 378 to a housing 379 and can be lowered and raised by a vertical rod 393. By reason of this vertical motion the welding device is moved into and out of the operative position. When the said welding device has come into the operative position, it is operated by a bell crank 386 which is pivoted in 387 and one end of which engages a fork of the rod 385. The other end of the bell crank has a roller which rides on a cam 388 which is operated by a chain wheel 389 actuated by the chain 7. The rotatable magazine is rotated intermittently by means of gear wheels 390, 391 and 206.

In summary the operation of the mechanism G is as follows:

When the glass stem has come into the operative position, the hollow mandrel 314 rises around the grid that has already been secured to the glass stem, after which the anode plate is bent around the said mandrel into a cylindrical shape by the members 309, 213 and 313 and the jaws 350, 351 and has its doubled end properly positioned relatively to the wires *a*. Then the lever 377 with the welding device is moved into the operative position, whereupon the welding pins 371 and 372 are moved inwardly and the anode plate is welded to the wires *a* of the glass stem. Then the mandrel 314 is lowered and the welding device is raised, the arrangement being such as to permit the glass stem to move to the position H.

Mounting the filament. (*Figures 23, 24 and 25*)

The filament mounting mechanism H is operated by a chain wheel 400 which is actuated by the chain 7 and which is fast on a shaft 401 journalled in the frame 1. This shaft has in addition mounted on it a gear wheel 402, a cam 403 and cam discs 404 and 420. On the frame 1 is mounted a pedestal 406 to which is pivoted a lever 408. This lever 408 is secured in 407 to a rod which is guided through the frame 1 and has a roller 410 riding on the cam 403. The lever 408 is thus moved against the action of a spring 409, said movement being transmitted by a fork 405 on the end of lever 408 and by a stud 411 to a slide 412. This slide is guided by a sleeve provided on a pedestal 417 and has in addition an opening through which a wire 414 can be passed. This wire 414 is wound on a bobbin 415 which is secured to the pedestal 417. By referring to Figure 25 the mechanism of the slide 412 will be better understood. As shown in said figure the stud 411 is pivoted in 433 to the slide 412. In addition it has two extensions 431 and 432. By means of a spring 430 secured to the stud 411 the latter tends to cause the projection 432 to bear on the slide 412. As the fork 405 of the lever 408 is moved to the right the extension 431 will be forced against the slide 412 and thus steady the wire 414. The slide 412 has connected to it a needle 413 which guides the wire 414 during the descending movement through the grid. After the needle 413 is lowered the protruding part of the wire 414 is gripped by a clip 419 (Figure 23) which is pivoted to the frame 1 and which is actuated by means of the cam 420 and a roller 416. The jaw of this clip is provided with a felt pad and when in closed position it clamps against a stationary stop 440 so as to grip the wire 414. During the ascending motion of the slide 412 the wire 414 is positioned between the hookshaped flattened ends of the supporting wires of the stem. In order that these hookshaped ends may be closed, heads 421 and 422 having clamping jaws 423 and 424 are provided which are actuated by a cam 425. By means of a shaft 426 this cam is rotated by a pinion 427 which engages the gear wheel 402. The jaws 423 and 424 have flat surfaces at their opposite ends on which cutters 435 and 436 are adapted to slide so as to sever the filament wire 414 after its attachment to the leading-in wires. The cutters 435 and 436 are secured to a lever 418 which is pivoted in 437 and has a roller riding on the cam disc 404.

After the filament wire is severed the grip of the jaws 423 and 424 is released, said jaws falling then back out of engagement with the glass stem so as to allow for its movement to the next position. This is position O where

the operator withdraws the finished mount from the carrier and replaces it by a new stem which is submitted to the same series of operations as hereinbefore described.

What I claim is:

1. A device of the character described, comprising a stationary frame, a rotatable table mounted on said frame, a chuck for holding a glass stem at the periphery of said rotatable table, and a plurality of mechanisms adjacent the periphery of said table for mounting electrodes on the glass stems in said chuck, the said mechanisms being mounted to move radially of said table, and common actuating means for moving said table step by step to bring said chuck into registry with said mechanisms in succession and to move said mechanisms in succession radially of said table to bring them into and out of the path of the traveling stem.

2. A device of the character described, comprising a stationary frame, means for revolving a glass stem, and a plurality of mechanisms for mounting electrodes on the stem, said mechanisms being arranged to periodically move in a radial direction with respect to the travelling stem.

3. A device of the character described, comprising a stationary frame, means on said frame for revolving a glass stem, means for combing the supporting and leading-in wires on the glass stem and means for shaping the outermost leading-in wires on the glass stem.

4. A device of the character described, comprising a stationary frame, means for revolving a glass stem with leading-in wires projecting radially of its path, means for shaping the outermost leading-in wires on the glass stem, and a hook forming mechanism comprising cooperating jaws for bending into hooks the ends of a plurality of said leading-in wires, said mechanism being mounted to reciprocate bodily and radially of said path to bring said jaws into and out of the proper relation to said ends of leading-in wires.

5. A device of the character described, comprising a shaft, a cam on said shaft, a slide to be actuated by said cam to move perpendicularly to the axis of said shaft, and means to be actuated by said slide for periodically combing the supporting and leading-in wires on a glass stem.

6. A device of the character described, comprising a vertical shaft, a horizontal slide to be reciprocated by said shaft, arms pivoted on said slide, teeth mounted at the ends of said arms, means to be actuated by said shaft for presenting a glass stem containing supporting and leading-in wires to the said teeth, and means to be actuated by said shaft for rotating the arms about their pivots and for reciprocating the slide to comb the wires.

7. A device of the character described, comprising a vertical shaft, a horizontal slide to be reciprocated by said shaft, arms pivoted on said slide, teeth mounted at the ends of said arms, means to be actuated by said shaft for presenting a glass stem containing supporting and leading-in wires to the said teeth, and means for rotating the arms about their pivots and for reciprocating the slide to comb the wires, the means for rotating the arms and reciprocating the slide being actuated from the same source as, and in timed relation with, the means for presenting the stem.

8. A device of the character described, comprising a fixed jaw, a movable jaw pivoted to the fixed jaw, a spring holding the movable jaw in clamped relation to the fixed jaw, and a housing on said fixed jaw projecting from said jaw with its end spaced away from the end of said jaw and in substantial alignment with the longitudinal axis of said jaws in position to support wires projecting from a stem held in said jaws.

9. A device of the character described, comprising a stationary frame, a shaft perpendicular to said frame, a table mounted perpendicular to said shaft and adapted to be rotated thereby, and means on said rotatable table for carrying a glass stem, said means comprising a jaw fixed relative to the rotating table, a movable jaw pivoted to the fixed jaw, a spring holding the movable jaw in clamped relation to the fixed jaw, and means secured to the fixed jaw for supporting the wires on the glass stem.

10. A device of the character described, comprising a stationary frame, a shaft perpendicular to said frame, a table mounted perpendicular to said shaft and adapted to be rotated thereby, and means on said rotatable table for carrying a glass stem, said means comprising a jaw fixed relative to the rotating table, a movable jaw pivoted to the fixed jaw, a spring holding the movable jaw in clamped relation to the fixed jaw, and means secured to the fixed jaw for supporting the wires on the glass stem, the stem carrying means holding the wires on the stem in a plane perpendicular to the surface of the rotating table.

11. A device of the character described, comprising a stationary frame, a rotatable table mounted on said frame, means on said table for holding a glass stem so that the wires of the stem extend substantially parallel to the table, and means for shaping the wires on the glass stem, said shaping means being movable in a path radial to the rotating table.

12. Means for cutting the supporting and leading-in wires on a glass stem, comprising means to present a glass stem to a wire cutting device comprising a slide reciprocating toward and away from said glass stem, arms pivoted on said reciprocating slide, cutters mounted at the ends of said arms, and means

to actuate the reciprocating slide and the arms to cause the latter to close the cutters on the supporting and leading-in wires, the cutters being adjustable to cut the wires to a predetermined length.

13. A device of the character described, comprising a stationary frame, means for revolving a glass stem, means on the frame for combing the wires on the stem, means on the frame for shaping the wires, means on the frame for severing the wires, and means on the frame for flattening the ends of the severed wires, said flattening means comprising a reciprocating slide, a movable punch, including a reciprocatable punch.

14. A device of the character described, comprising means to support a glass stem, a shaft, a slide perpendicular to the axis of the shaft to be reciprocated thereby, a punch fixed to the slide, a second shaft parallel to the first shaft, an eccentric on the second shaft, and a second punch actuated by said eccentric to approach the fixed punch and thereby flatten the ends of the wires on the stem.

15. A device of the character described, comprising a stationary frame, means for revolving a glass stem, and means for doubling a plurality of leading-in wires on the glass stem, said doubling means having a lever about which the wires are bent and a pivoted member adapted to bend the wires.

16. Means for doubling a wire on itself, comprising means for supporting the wire, a rotating shaft, a slide perpendicular to the axis of the shaft and adapted to be reciprocated thereby, a lever pivoted on said slide to act as an anvil during the bending operation, a second lever pivoted to the slide and having at one end thereof a bending arm, and means for reciprocating the slide and actuating the levers on the slide for bending the wire.

17. A device of the character described, comprising means to support a glass stem, means for combing the wires on the stem, means for shaping the wires, means for severing the wires, means for flattening the ends of the wires, and means for doubling the wires on themselves, said doubling means comprising a pivoted anvil and a pivoted bending member.

18. Means for mounting and welding a grid to its supporting wires, comprising means for supporting a glass stem containing the supporting wires, a rotatable magazine, means on said magazine for carrying a grid, welding means adapted to move tangentially to the path of the rim of the rotatable magazine, and means for rotating the magazine into position to bring the grid into proper relation to the supporting wires and for moving the welding means into position to weld the grid to its supporting wires.

19. A device of the character described, comprising a vertical rotatable shaft, means for horizontally presenting a glass stem to an anode forming mechanism comprising a table mounted perpendicular to the shaft and rotated thereby, means on said table for clamping a plate flat throughout its major portion and bent at right angles at two of its ends, a vertically movable cylindrical mandrel actuated by said shaft, means to bend the plate about the mandrel to form a butt-ended cylinder, and means to weld the anode cylinder to its supporting wires on the glass stem.

20. Means to shape electrodes, comprising a rotatable carrier adapted to hold the raw material to be shaped, a mandrel adapted to move in a direction perpendicular to the path of the rotating carrier, means adapted to bend the raw material partly around the mandrel, a plurality of jaws adapted to surround the mandrel on the far side to complete the bending operation, and means to weld the formed electrode to a supporting member.

21. A device of the character described, comprising means for holding a glass stem, means for holding a supply of filament wire, reciprocating means for withdrawing the filament wire from its holding means, a hollow needle adapted to receive the wire, means for moving the needle into position relative to the glass stem, means for clamping the working end of the filament wire against movement, means for withdrawing the needle, and means for fastening the filament wire to its supporting wires on the stem and for severing the proper length of filament wire.

22. A device of the character described, comprising a vertical shaft, a horizontal stationary frame mounted perpendicular to said shaft, means for supporting a roll of filament wire on said frame, a vertically reciprocatable lever adapted to feed the filament wire from its supporting member, a vertically movable hollow needle adapted to receive said filament wire, means for holding a glass footstep in position underneath the hollow needle, means for moving said hollow needle downwardly into position, means for clamping the working end of the filament wire against upward movement, means for withdrawing the needle upwardly, means for fastening the filament wire to its supporting wires on the glass footstep, and means for severing the proper length of filament wire.

23. A device of the character described comprising a chuck for holding a glass stem with projecting wires, means for combing said projecting wires on the glass stem comprising a pair of co-operating toothed jaws mounted to move bodily away from said chuck in a direction lengthwise of the projecting wires of the glass stem, and actuating mechanism for closing said jaws adjacent said chuck and moving said jaws while closed bodily away from said chuck.

24. A device of the character described comprising a chuck mounted to travel in a circular path and to hold a glass stem with projecting wires extending radially of said path, means for combing said radially projecting wires on the glass stem comprising grooved combing jaws mounted adjacent said path to close about the projecting wires on a stem in said chuck and to move bodily away from said chuck in a path radial to the circular path of the glass stem, and common actuating means for moving said chuck along its path into registry with said combing means and simultaneously closing said combing jaws and moving said jaws bodily away from said chuck.

25. In a mount making machine, the combination of a stem chuck and an electrode chuck mounted to travel along curved paths and register with each other at a pre-determined point, said chucks being mounted to hold an electrode and a stem with lead wires projecting from said stem chuck in position to cause said electrode to engage said stem lead wires when said chucks register with each other, a fastening device mounted at said point adjacent said paths to fasten said electrode to said stem lead wires, and common actuating means for moving said chucks into registry and actuating said fastening device to fasten said stem lead wires to said electrode.

26. In a mount making machine, the combination of two rotatable carriers mounted adjacent each other to rotate about different axes, a stem chuck mounted on one of said carriers to hold a stem with lead wires projecting radially from said chuck, an electrode chuck mounted on the other carrier to hold an electrode with a portion thereof projecting into the path of the lead wires on a stem in said stem chuck at a pre-determined point in its travel, a welding device mounted at said point and comprising welding electrodes movable into and out of the path of the ends of the lead wires of a stem in said stem chuck, and common actuating means for moving said carrier step by step to bring said chucks adjacent each other at said point and thereby bring the ends of said lead wires and the projecting portion of said electrode into engagement, actuating said welding electrodes to advance them into contact with said lead wires and said electrode and then withdraw them, and opening said electrode chuck.

27. In a mount making machine, the combination of a stem chuck and a grid chuck mounted to travel along curved paths into registry with each other at a pre-determined point, said chucks being mounted to hold a stem and a grid with lead wires projecting from said chucks in position to overlap when said chucks are in registry, a fastening device mounted at said point adjacent said paths to join said overlapping stem and grid lead wires, and common actuating means for moving said chucks into registry, maintaining said overlapped wires relatively immovable, and actuating said fastening device while said wires are overlapped.

28. In a mount making machine, the combination of a stem chuck mounted to travel along a pre-determined path, said chuck being mounted to hold a stem with lead wires projecting from said chuck, a grid chuck mounted to travel along a path which at a pre-determined point is adjacent the path of said stem chuck, said grid chuck comprising cooperating jaws for holding grid leads with their ends projecting into the path of said stem leads at said point, whereby said grid leads and said stem leads overlap at said point, a wire welding device at said point adjacent said paths and comprising a pair of cooperating welding electrodes mounted to move tangentially of the path of said stem chuck to close upon a pair of said overlapping leads, and common actuating means for moving said chucks to bring them adjacent each other and thereby overlap said grid and stem leads, and for actuating said welding electrodes while said leads are overlapped whereby said grid is welded to said stem leads.

29. In a mount making machine, the combination of a stem chuck mounted to travel along the pre-determined path and to hold a stem with lead wires projecting from said chuck, of an electrode shaping mechanism mounted adjacent the path of said stem chuck and comprising a holder for engaging an electrode near its extremities, a mandrel movable into registry with said chuck and to adjoin the electrode in said holder, bending jaws movable transversely of said mandrel to bend the electrode in said holder around said mandrel until its extremities are in contact with the lead wires of a stem in said chuck, and driving means for actuating said mandrel and said bending jaws in sequence, a fastening device mounted adjacent said point to fasten said lead wires to said electrode, and common actuating means for bringing said chuck into registry with said electrode shaping mechanism, actuating the driving means of said mechanism, and actuating said fastening device.

30. In a mount making machine, the combination of a stem chuck mounted to travel along the pre-determined path and to hold a stem with lead wires projecting from said chuck, of an electrode shaping mechanism mounted adjacent the path of said stem chuck and comprising a fork for holding a flat plate by the edges, a slotted mandrel mounted adjacent said fork to move lengthwise of said fork into position over the end of a stem in said chuck with the lead wires of said stem in the slot in said mandrel, a reciprocating die

movable transversely of said fork to bend the plate in said fork around said mandrel, bending jaws pivoted adjacent said fork to further bend said plate to bring its edges around said mandrel into contact with said lead wires, and driving means for actuating said mandrel, said die, and said bending jaws in sequence, a fastening device mounted adjacent said point to fasten said lead wires to said electrode, and common actuating means for bringing said chuck into registry with said electrode shaping mechanism, actuating the driving means of said mechanism, and actuating said fastening device.

31. In a mount making machine, the combination with a stem chuck mounted to travel along a pre-determined path and to hold a stem with lead wires projecting from said chuck, a filament mounting mechanism mounted adjacent the path of said chuck and comprising a reciprocating filament feeder movable in alignment with two of the lead wires of a stem in said chuck, filament fastening means for securing a filament to said lead wires, and common actuating means for moving said chuck into registry with said filament mounting mechanism and then actuating said filament feeder and said filament fastening means.

32. In a mount making machine, the combination with a stem chuck mounted to travel along a pre-determined path and to hold a stem with lead wires projecting from said chuck, a filament mounting mechanism mounted adjacent the path of said chuck and comprising a reciprocting filament feeder movable in alignment with two of the lead wires of a stem in said chuck, filament fastening means for securing the filament to said lead wires, a cutter mounted adjacent said filament feeder to cut the filament wire adjoining one of the lead wires, and common actuating means for moving said chuck into registry with said filament mounting mechanism and then actuating said filament feeder, said filament fastening means, and said cutter.

33. A device of the character described comprising a stationary frame, a rotatable table on said frame, a chuck on the periphery of said table having two cooperating relatively movable jaws for holding a glass stem having wires projecting from it, means for holding said jaws closed to hold the stem with said wires projecting from said chuck, and a housing adjacent said chuck in position to support the projecting wires of the glass stem in said chuck.

WALTHER DALHEIMER.

CERTIFICATE OF CORRECTION.

Patent No. 1,901,087. March 14, 1933.

WALTHER DALHEIMER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 55, after "glass" insert "stem"; page 4, line 64, for "table" read "frame", and line 65, for "143" read "153"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of August, A. D. 1933.

M. J. Moore.

Acting Commissioner of Patents.

(Seal)