Nov. 30, 1943. R. B. THOMAS ET AL 2,335,617

LAMP SEALING APPARATUS

Filed Aug. 17, 1940 5 Sheets-Sheet 1

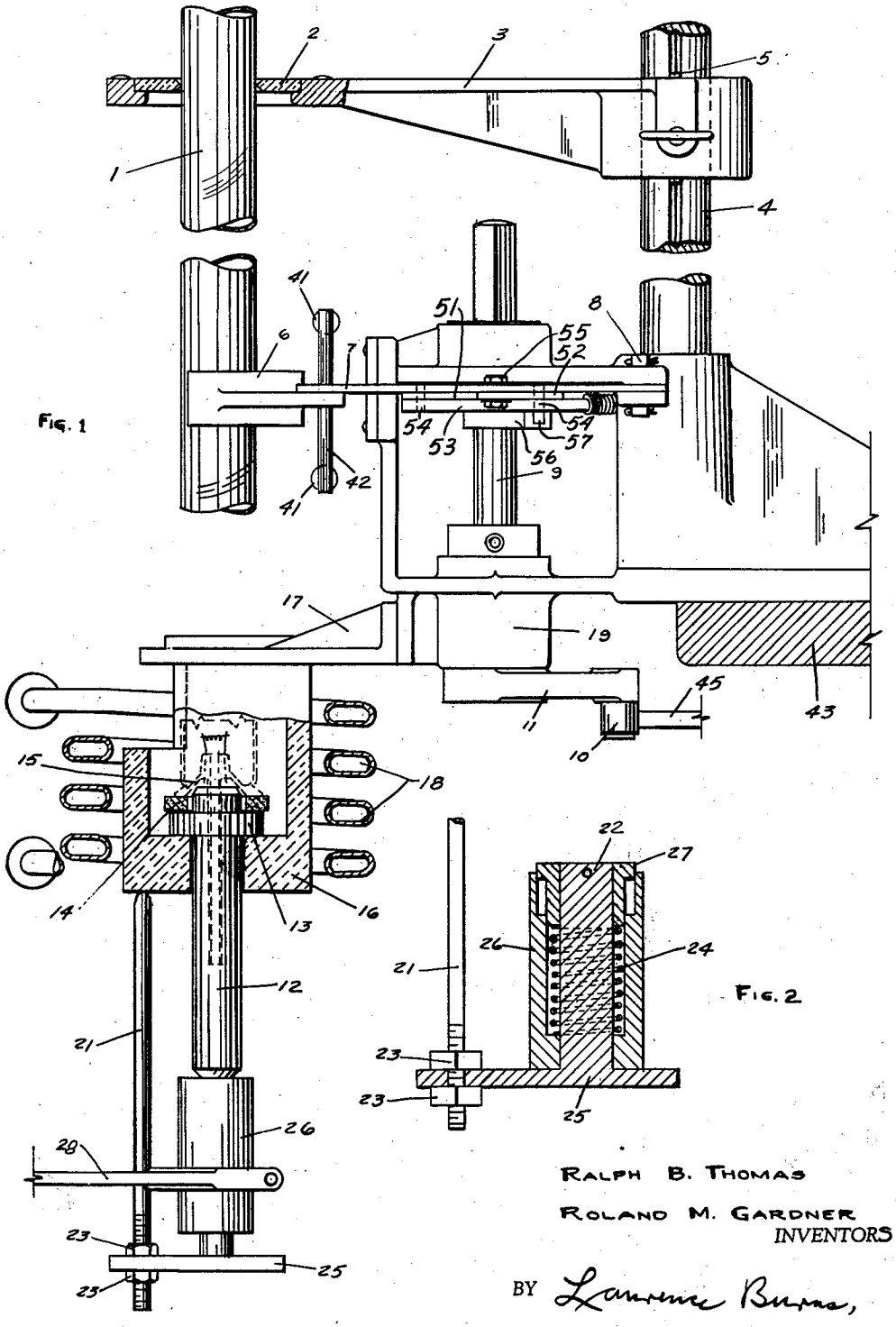


Fig. 1

Fig. 2

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LAMP SEALING APPARATUS

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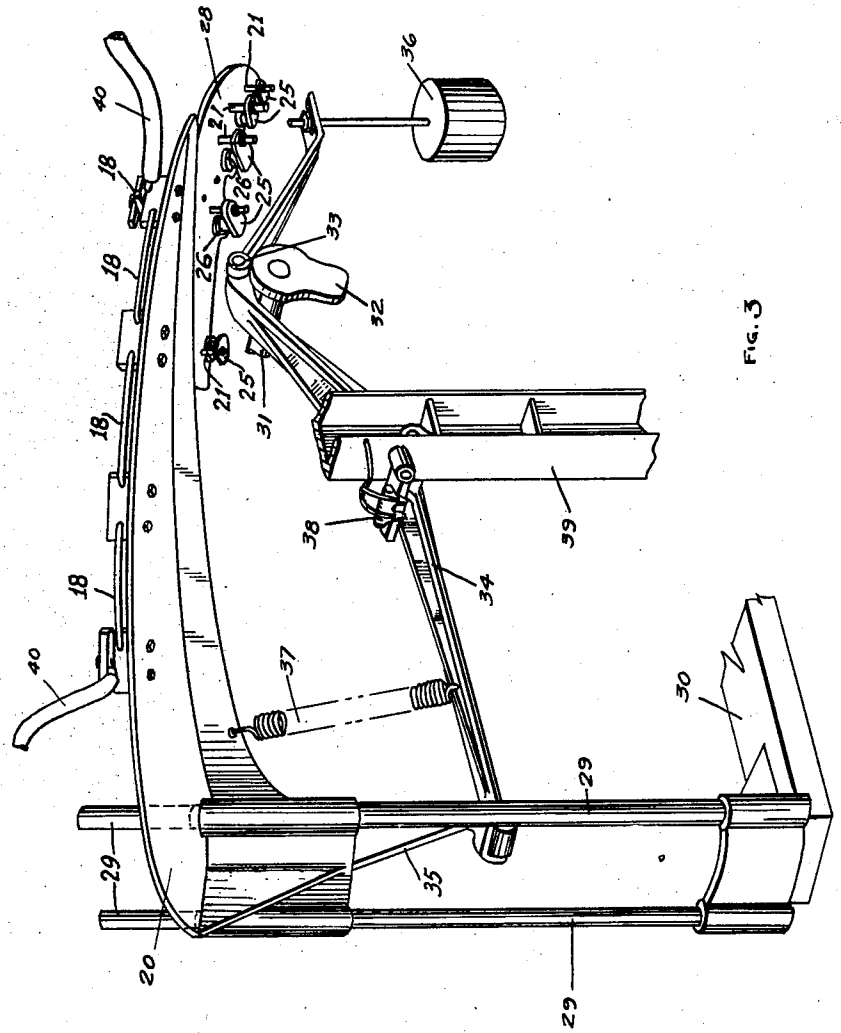


FIG. 3

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LAMP SEALING APPARATUS

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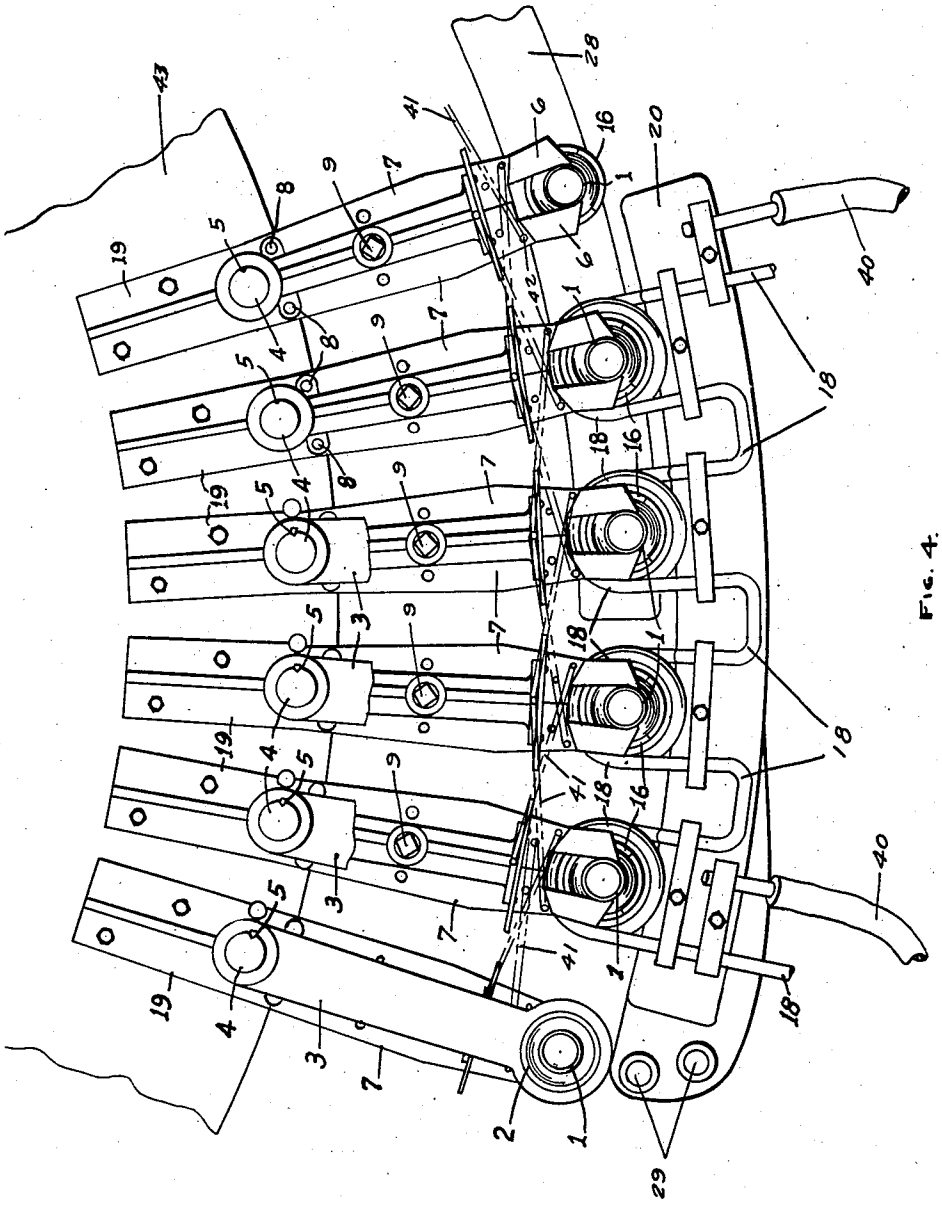


Fig. 4.

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LAMP SEALING APPARATUS

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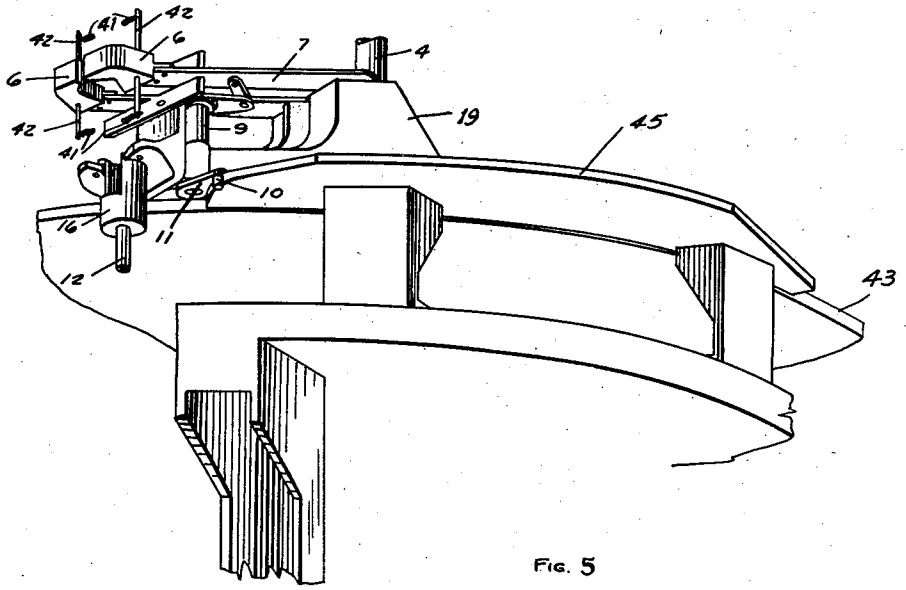


FIG. 5

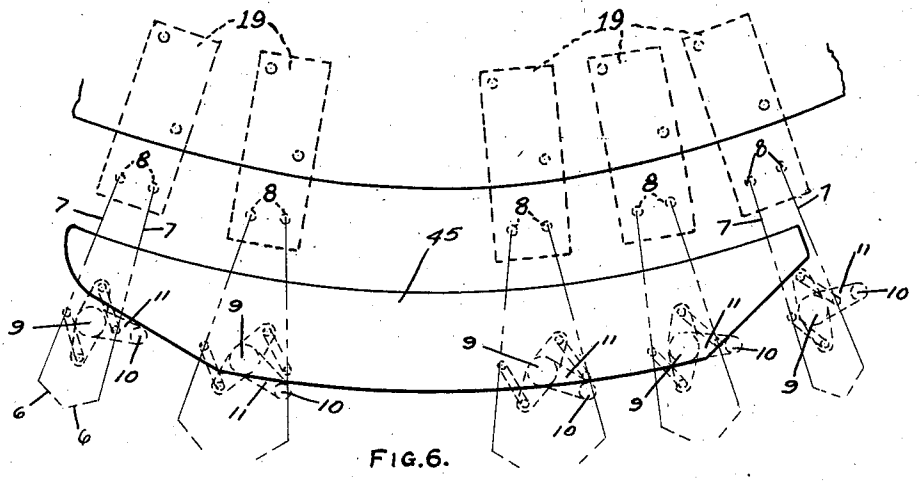
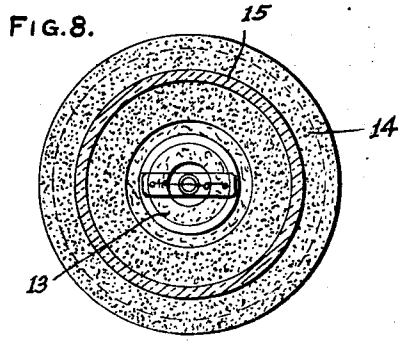


FIG. 6.

FIG. 8.



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LAMP SEALING APPARATUS

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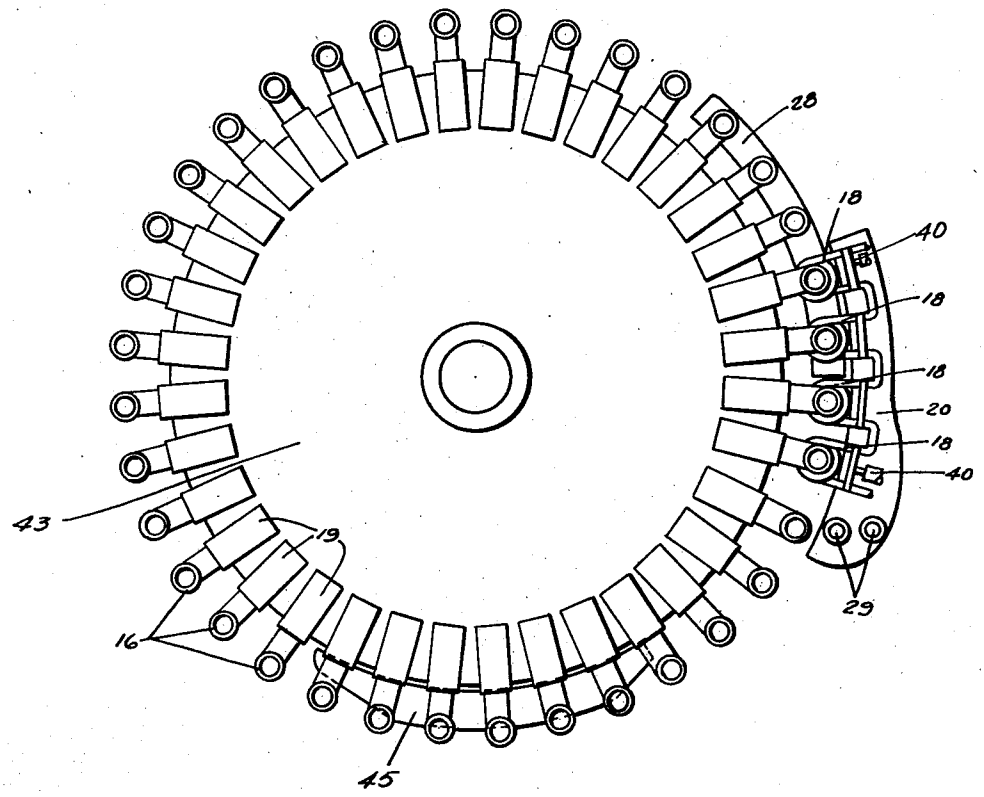


FIG. 7.

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Patented Nov. 30, 1943

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UNITED STATES PATENT OFFICE

2,335,617

LAMP SEALING APPARATUS

Ralph B. Thomas, Beverly, and Roland M. Gardner, Swampscott, Mass., assignors to Sylvania Electric Products Inc., a corporation of Massachusetts

Application August 17, 1940, Serial No. 353,100

1 Claim. (Cl. 49—2)

This invention relates to electric gaseous discharge lamps and in particular to the sealing of the stems to the glass envelope of such lamps.

An object of this invention is to provide an accurately aligned seal between the bulb and stem of such a lamp.

Another object is to provide a sealing apparatus that will not result in foreign gases or vapors being sealed into the lamp due to the type of apparatus employed to effect the seal.

A further object is to provide the lamp with a roughened seal in order to bind the seal better to the cement used for attaching the base to the lamp.

Another object is to provide a simple yet efficient and quick electrical method of sealing the stem and bulb of the lamp.

Other objects and advantages of this invention will be apparent from the following specification taken in conjunction with the accompanying drawings in which:

Figure 1 is a side elevational view of the sealing head assembly shown partly in section.

Figure 2 is a detail of the mount pin pusher shown in section.

Figure 3 is a side perspective view of the carrier plate unit, and the cam mechanism which operates it.

Figure 4 is a top view of the sealing machine turret and several of the heads attached thereto shown in their relation to the high frequency induction coils.

Figure 5 is a perspective view of the cam action for the jaws viewed from below.

Figure 6 is a plan of the cam contour with the jaw mechanism shown schematically.

Figure 7 is a plan view of the lamp sealing machine.

Figure 8 is a plan view of the refractory flange, the carbon ring and the stem.

Similar reference characters refer to similar parts in the several views of the drawings and in the specification which follows.

In Figure 1, sections of the lamp bulb 1, are shown to illustrate the position which the bulb assumes in relation to the rest of the lamp sealing apparatus. When the bulb is being placed in the sealing machine, the upper end of the bulb is inserted through the guide plate, 2, located on the guide plate holder, 3, which is attached to the guide rod 4 in an adjustable manner. By providing a means for adjusting the height of the guide plate holder, 3, the guide plate and its holder may be raised or lowered on the guide rod 4, thereby becoming adjustable in height to accommodate bulbs of varying lengths. The guide plate seated in the guide plate holder may be readily removed from its position and be replaced by a plate having a larger or smaller opening through which the bulb extends, thereby providing for bulbs of various diameters.

The guide plate holder, 3, is keyed to the guide rod 4 through the V shaped key 5 in a manner as to permit only vertical adjustment and to prevent any rotating motion. The prevention of rotating motion is of paramount importance because if the guide plate holder should rotate even slightly about the guide rod 4, the bulb which is being held in place will be out of alignment and a crooked or imperfect seal will result.

The lower extremity of the bulb is held in place by the jaws 6. These jaws 6 are attached to the jaw arms 7 which pivot about the studs 8. The jaws are opened and closed by means of a linkage mechanism which is actuated through the head cam shaft 9. The links 51 and 52 have one end thereof fixed to the jaw cam 53 through the pins 54. The other ends of these links 51 and 52 are pivotally mounted about the studs 55, one of which is on one side of the shaft 9 and the other on the other side thereof. Thus when the shaft 9 turns, the jaw cam 53 through which it extends will be turned by the movement of the cam 56 against the pin 57. Since the links 51 and 52 have one end thereof fixed to the ends of the jaw cam, the rotating movement of the jaw cam will be transmitted through the links 51 and 52 to the jaws and cause them to open. This shaft 9 is in turn actuated through the cam roller 10 and cam follower 11. These in turn are actuated by the cam track 45 which is attached to the base of the machine. When the indexing head has completed its sealing cycle, and the lamp is ready to be removed from the turret machine 43, the cam roller 10 will strike against the cam track 45, turning the cam shaft 9 through the cam follower 11, thus opening the jaws against the tension of the spring 41. The cam track 45 is of a contour such that it will keep the jaws 6 open during the loading and unloading positions. Since the jaws are open during the loading positions, the bulb is able to center itself on the conical stem seated on the carbon ring 14. When the head passes from the loading positions and is approaching the sealing positions the contour of the cam track 45 is such as to permit the jaws 6 to close about the bulb 1.

The refractory flange 13, forming the top of the refractory mount pin 12 provides a seat for the carbon ring 14. It is on this carbon ring that

the stem 15 is placed, with the exhaust tube and lead-in wires of said stem extending down inside the refractory mount pin 12. The lamp bulb 1 is placed on the machine in a manner as to be held in its proper place by the guide plate, 2, having the neck of the bulb in contact with the flare of the stem 15 on the carbon ring 14.

The refractory pin 12 is fitted in the refractory cup 16 in a manner as to allow free movement of the pin vertically but not horizontally. This cup 16 is attached to the metal cup chair 17 mounted and bolted to the head 19. Below the refractory cup is the coil conductor 18. This coil may be of edgewise wound copper ribbon, or hollow copper tubing. If hollow copper tubing is used as it is in this case, water is passed through the inside of the tubing for cooling purposes. It is advisable to connect the ends of the metal tubing to the water inlet and outlet through short pieces of rubber tubing to reduce high frequency power loss from the coil.

The coil 18 is energized by passing through it a current of high frequency, say one million cycles per second. This heats the carbon ring 14 by induction, the ring acting as a closed turn of a transformer. The ring may thus be heated to a temperature sufficient to fuse the bulb 1 and the stem 15.

In operation, the bulb, 1, is placed on the machine so that the upper end of the bulb is through the guide plate 2 and the lower end of the bulb is in a position to be gripped by the jaws 6 and the neck of the bulb is resting on the stem 15 seated on the carbon ring 14. After the head in which the bulb is located has indexed from the loading position and has reached a position just prior to the actual sealing positions, the jaws 7 firmly grip the bulb holding it securely in place.

The actual sealing of the bulb to the stem is performed in several progressive operations in which the head with a bulb and stem therein is acted upon by the coils 18. There are four coils similar to coil 18. These coils are mounted on the carrier plate 20 as shown in Figure 3. The apparatus as shown in Figure 3 is located beneath the heads of the machine and the cam mechanism shown therein serves to move the plate 20 to which the coils 18 are attached. The motion of this plate is a vertical one and is synchronized with the indexing of the heads on the machine so that as soon as a head has completed an indexing motion and moved to a point directly above these coils attached to the plate 20, the cam mechanism shown in Figure 3 lifts the carrier plate 20 up sufficiently to cause the coils attached to the plate to encircle the refractory cups 16 normally directly above the coils. When the coil is in this position, it heats the carbon ring 14 which in turn heats the stem 15 and the neck of the bulb 1. The coils 18 may have different numbers of turns, the first having less than the last. The reason for this is to provide a gradual rather than a sudden increase in heat as the bulb passes through the various sealing positions. In this manner, the bulb will not become heated too quickly and strains in the glass and cracked seals are thereby avoided.

It must be remembered that during this entire sealing process the jaws 6 in which the bulb is held grip the bulb with a tension sufficient to hold it in exactly the same position throughout the sealing process. Thus, during the first two positions where the neck of the bulb and the stem 15 on the ring 14 are being heated for fusion purposes, the bulb is held in a fixed position and will not sag or drop down by reason of its weight on the softening neck of the bulb. Since the glass is fairly well softened after the first two positions, there is an adjustable non-inductive rod 21 which is attached to the metal mount pin pusher 22, located far enough below the inductance coils so as not to become inductively heated by it. The adjustment of the rod 21 is made through the adjusting rod nuts 23 and results in a greater or lesser height of the rod above the pin pusher 22 to which it is attached.

Thus when the bulb reaches the third coil position, the bulb neck and the flare of the steam has been softened sufficiently to allow working of the glass. When this third coil moves up, the pusher 22 will push up against the bottom of the mount pin 12, thus compressing the spring 24, shown in Figure 2. The compression on the spring 24 is gradually expended in pushing the mount pin 12 upward as the neck of the bulb and the flare of the stem are gradually softened by the inductively heated carbon ring 14 on which they rest. A similar operation takes place when the lamp reaches the fourth coil position. This pressure exerted through the mount pin 12 pushes the lamp stem 15 against the neck of the bulb thus firmly merging the glass to form the seal. The distance through which it is possible to move the softened stem is fixed by the relation between the rod 21 and the pin pusher 22. Thus any small variation in the vertical position of cup 16 will not affect the distance through which the softened stem is pushed.

As shown in Figure 3, for two or three positions following the last coil position, an adjusting rod mechanism as shown in Figure 2 is employed to limit the drop of the softened glass and to perfect the seal. This is necessary by reason of the fact that in the four coil positions, the glass has been softened considerably. Since the seal was compressed, it must be allowed to stretch a little to prevent strains and to obtain a more perfect seal. The length of this stretching is controlled by the height of the adjustable rod 21. The setting of rod 21 used at this position will be different from the setting in the softening position by the amount of dropping allowed.

Figure 2 shows a cross-section view of the mount pin raising mechanism which aids in the formation of the seal. The number of these pin raisers may vary according to the size of the lamp. This mechanism consists of the adjusting rod 21 which is threaded into the casting 25, said casting having a circular stud pin pusher 22 which is freely mounted in the bushing 26. This bushing 26 is shouldered at its lower extremity to allow a bearing surface for the spring 24 within which the stud of the casting may move. The upper extremity of the spring 24 is retained by the cap 27 which shoulders the spring and is freely fitted with the counter-bored upper extremity of the bushing 26. These mount pin raising devices are mounted on the auxiliary carrying plate 28 which is attached to the main carrier plate 20 as shown in Figure 3, the bushing 26 being fixed to the plate 28.

Figure 3 shows the main carrier plate 20, its auxiliary 28, and the cam operating mechanism for raising and lowering the same. The plate 20 slides on the ways or rods 29 which are mounted on the pedestal 30 which is secured to a stationary support. The inductance coils 18 and the auxiliary carrier plate 28 on which the pin raising devices are mounted, are carried as a unit on the main carrier plate 20.

The cam 32 is keyed to the cam shaft 31 connected through reduction gear to the motor which actuates the indexing of the machine. The cam roller 33 is affixed to the transmitting arm 34. On one end of this arm 34 is mounted a pivoting rod 35 which translates the motion of the arm 34 into the vertical motion of the carrier plate unit. The contour of the cam is such that it provides for the carrier plate unit to clear the lower extremity of the heads when said heads are in the process of indexing. After the indexing motion has ceased, the carrier plate unit will move up to allow the coils 18 to encircle the refractory cups 16. This upward motion is accomplished by the return weight 36 aided by the spring 37 when the cam follower reaches that position along the contour of cam 32 which allows this returning motion. This weight 36 is attached to an end of the transmitting arm 34.

A mercury switch 38 is attached to the pillar 39 which acts as a fulcrum for the transmitting arm 34. This switch extends out from the pillar 39 and over the transmitting arm 34 in such a manner that it controls the coil actuating high frequency current, by some well known connection such as, for example, that used for keying high frequency radio transmitters. When the arm 34 moves to raise the carrier plate unit the mercury switch will be closed as shown in Figure 3 thereby energizing the heating coils. When the arm 34 moves to lower the carrier plate unit the mercury switch pivoting on the pillar 39 will be thrown open as a result of its contact with the transmitting arm 34, thus throwing off the high frequency current while the machine is indexing. This serves to conserve the copper induction coils by avoiding excessive heating and also serves to prevent the glass being heated from cracking due to too rapid a rise in temperature. Since the coils cool between each indexing motion, they must gradually warm up again when they return to encompass the refractory cup 16.

Figure 4 is a top view of the lamp sealing machine showing the relative positions of the lamp sealing heads, the turret to which the heads are attached and the carrier plate unit on which is mounted the inductance coils and the mount pin pushers. It also shows the leads 40 through which the high frequency current flows to energize the heating coils 18. This figure also shows the series of springs 41 attached to the studs 42 mounted on the arms 7 of the jaws 6. These jaws are opened and closed through the action of the head cam shaft 9 which is normally automatic in its function of opening and closing the jaws, but its upper extremity is square so as to accommodate a wrench or other manual tool whereby the jaws may be opened at will at any time. The reason for this is to permit the removal of an imperfect bulb or stem discovered after the bulb and stem has been placed in the head of the machine.

Unless the surface of the carbon rings on which the stems rest is in the soft or graphite form, the carbon rings may stick to the glass. It is often convenient to use pressed carbon rings which may be initially hard or not completely graphitized. For this reason, it is advisable to send the carbon rings on a complete circuit through the coils at least once before using the rings to seal the glass. This makes the graphitizing more complete, and also insures preheating of the carbon rings, thus requiring less energy in the coils to bring the rings to the proper temperature and reducing the change in temperature of the glass effected at the first coil position. In some cases, rings of a form of silicon carbide may be used.

Figure 5 shows the position of the cam track 45 in relation to the base of the machine and in relation to the sealing heads, one of which is shown in this figure. Figure 6 shows the contour of the cam track 45 and the manner in which the cam roller 10 comes into contact with the cam track and thereby turns the cam shaft 9 through the cam follower 11. This cam track as shown in Figure 6 is of a contour as to keep the jaws of the heads open during the loading and unloading positions.

Figure 7 shows the whole 360° of the turret machine 43 with the plurality of heads 19 mounted thereon and the plurality of refractory cups 16 mounted in said heads. It shows the cam track 45 which is located beneath the heads 19 and which, as was described above, serves to open the jaws which grip the bulb. This figure also shows the plate 20 which carries the conductor coils 18. These coils, as was pointed out above, are energized by passing through them a current of high frequency through the leads 40. This main carrier plate 20 slides on the ways 29 as shown in Figure 3. The auxiliary carrier plate 28 is the element on which several of the seal compressing devices shown in Figure 2 are mounted.

Figure 8 is a plan view showing the refractory flange 13 forming the top of the refractory mount pin 12 and providing a seat for the carbon ring 14 on top of which the stem 15 is placed.

What we claim is:

A machine for sealing a glass stem to a tubular glass bulb, said machine comprising: a series of fixed heads; a carrier for supporting and advancing said heads to a plurality of fixed stations; a pair of jaws on each of said heads for holding the bulb in fixed position vertically during the movement thereof through the plurality of stations; a refractory cup attached to each of said heads below said pair of jaws and in alignment therewith; a refractory pin fitted through each of said refractory cups; a refractory button fixed to the top of each of said refractory pins and seated on the floor of said refractory cups; a carbon ring for holding the stem to be sealed to said bulb seated on each of said buttons; means in at least one of said stations for heating said carbon ring sufficiently to melt adjacent portions of said stem and said bulb; and an automatically operable lifting unit at said melting station for resiliently pushing said refractory pins upward to compress the said stem and bulb melted portions and effect a seal thereby; said lifting unit having a stop member for limiting the extent of said resilient pushing action.

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