

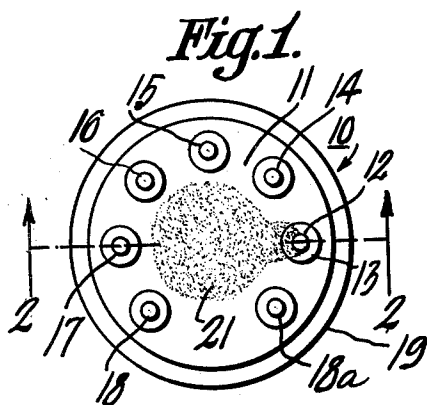
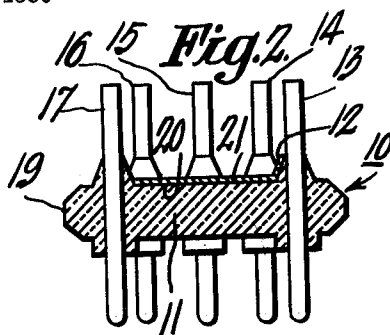
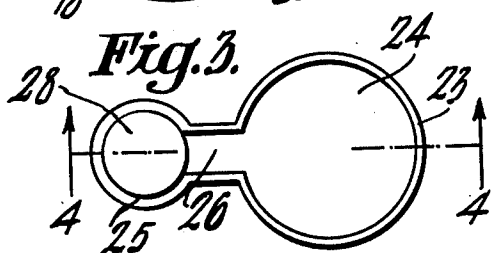
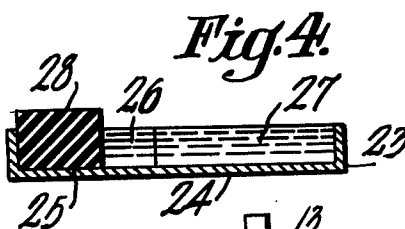
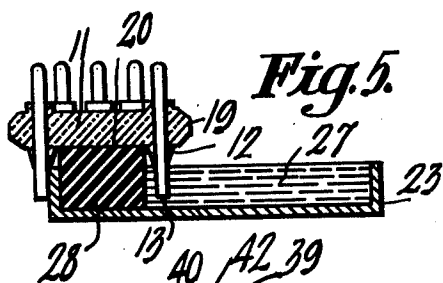
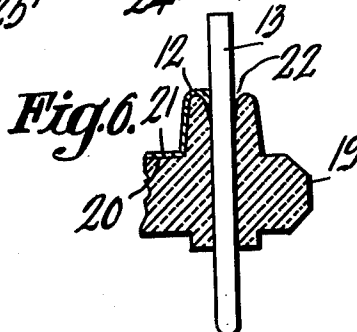
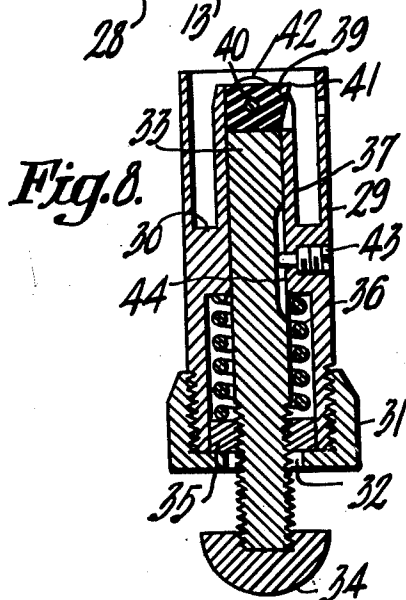
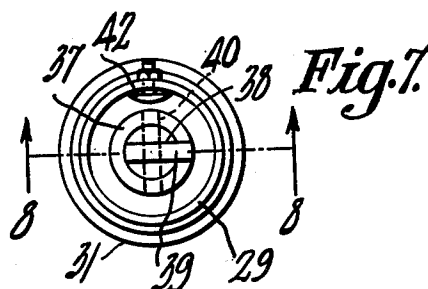
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APPARATUS FOR NONUNIFORMLY COATING OBJECTS OF IRREGULAR FORM

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OBJECTS OF IRREGULAR FORMWilliam John Bachman, Florham Park, N. J., as-  
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This invention relates to a method and apparatus for coating predetermined portions of an irregularly formed object, and more particularly to a method and apparatus for coating a portion of a stem sub-assembly of an electron tube and one or more lead-ins extending through the stem with a continuous layer of conducting material.

Some types of electron tubes have flat glass stems, and require shielding between certain of the lead-ins, such as the input and output lead-ins, for satisfactory operation of the tubes. The required shielding is electrostatic in character and is usually accomplished either by a metal disc adjacent the inner surface of the flat stem and between the lead-in array, or by a coating of a conducting material, such as silver, on the inner surface of the stem and extending to one or more lead-ins for connection of the coating to an appropriate potential source.

Where a coating of the type referred to is used, it is usually applied prior to sealing the stem to a bulb. However, because of irregularity in form of the structure comprising the stem and lead-ins extending thereto, a problem is presented in rapidly and satisfactorily applying the coating. The irregularity is occasioned by the fact that the glass part of the stem includes a flattened portion and a plurality of glass fillets extending from the flattened portion and lead-ins extending through the fillets. The contour of a properly applied coating would therefore be subject to appreciable variation. Thus, a portion of the coating would follow the flat portion of the stem, another portion would engage one or more fillets, and another portion of the coating would cover a portion of one or more lead-ins. It is apparent that if the entire coating is applied by a single pad containing the coating material, the pad should have the irregularity represented by the portions of the stem to be coated. Such irregularity in the pad would in turn present a problem of replenishing the supply of coating material on the pad.

In most cases where a coating of the type referred to is utilized, it is extended to engage only one lead-in. However, since each lead-in of the stem is of predetermined and different utility in the completed device in which the stem is used, it is necessary that the coating be applied to a lead-in having a predetermined orientation in the lead-in array. This presents a further problem in addition to that occasioned by the irregularity in the form to be coated.

Another problem is presented when a flat glass

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stem having glass fillets extending therefrom and lead-ins extending through the fillets, is to be coated in the manner described. The face of the stem to be coated is sometimes the face from which extended portions of the lead-ins intended for connection to electrodes in the completed device. In view of the electrical connections made to these portions, as by welding, it is necessary that these portions be free from glass. Therefore, during the step of sealing the lead-ins through the stem the lead-ins are pulled down after extension through the softened glass of the stem. This pull down step causes portions of the lead-ins that may have become wetted by the softened glass to be pulled into the glass of the fillets. A result of this pull down is the formation of an annular depression in the free end of each of the fillets adjacent the lead-ins. The portions of the fillets and lead-ins at this depression present a serious problem of accessibility for application of the coating of these portions. Unless these portions are coated, a break in the electrical connection between a predetermined lead-in and the coating occurs which defeats the purposes of the coating.

A further problem arises in applying a conductive coating to an electron tube stem. While certain critical surfaces of the stem should be coated to provide a desired electrostatic shield, certain other surfaces should be free from the coating. One surface in particular that should be free from coating material is the peripheral surface of the stem to which a bulb is sealed during fabrication of an electron tube. Coating material on the periphery of the stem would interfere with a proper seal between the stem and bulb.

Accordingly, an object of the invention is to provide an improved apparatus and method for applying a coating to an irregularly shaped structure, such as the stem assembly of an electron tube.

A further object is to provide an apparatus for coating predetermined portions of an electron tube stem including a lead-in extending there-through.

Another object is to provide an improved apparatus and method for applying a continuous conductive coating to a central portion of an electron tube stem and to a predetermined fillet of the stem and a lead-in extending through said fillet for electrically connecting the coating to a suitable potential source.

According to one aspect of the invention an improved apparatus and method of applying a coat-

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ing to an irregularly shaped object, such as the stem of an electron tube having fillets and lead-ins extending therethrough, are provided. The apparatus includes a reservoir of vertically spaced supplies of the coating material with which the central portion of the stem and a predetermined lead-in are placed in engagement. The supply of coating material is more copious at the portion thereof engaged by the lead-in.

In practicing the novel method of the invention the stem assembly is held with the central portion thereof to be coated facing a downward direction. It is then lowered over the vertically spaced portions of the reservoir of the apparatus of the invention until the central portion of the stem engages the higher of the vertically spaced supplies of coating material and a predetermined lead-in extends into the lower and more copious supply of the material. This results in the application of a stable coating on the central portion of the stem. The predetermined lead-in receives a thicker coating than that received by the central portion of the stem. This thicker coating is unstable and responds in flow when the stem is removed from the coating reservoir. Therefore, during the next step of the method, which involves raising the stem from the reservoir and inverting it, the free flowing coating on the lead-in referred to flows downwardly to effectively coat the fillet through which the lead-in extends and to join the coating applied to the central portion of the stem.

When the coated lead-in is subsequently connected to a suitable potential source, the coating on the central portion of the stem will also be electrically connected to this source.

According to another aspect of the invention, the apparatus includes a deformable reservoir of coating material. When the apparatus and the stem to be coated are brought into pressure relationship the reservoir is deformable to engage the central portion of the stem, a predetermined fillet of the stem and a lead-in extending through the fillet referred to.

Further objects and advantages of the invention will become evident as the description proceeds.

While the invention is pointed out with particularity in the appended claims it may best be understood from the following detailed description of two embodiments thereof, presented solely for illustrative purposes and not by way of limitation, taken in connection with the appended drawing in which

Figure 1 is a plan view of an electron tube stem coated according to the invention;

Figure 2 is a sectional transverse view along the line 2—2 of Figure 1;

Figure 3 is a plan view of one form of apparatus useful in practicing the invention;

Figure 4 is a cross-sectional view along the line 4—4 of Figure 3;

Figure 5 is a sectional elevation showing an electron tube stem in position for receiving an initial coating by the apparatus of the invention;

Figure 6 is an enlarged fragmentary sectional view of the stem shown in Figure 5, after a coating has initially been applied by the apparatus and after the stem has been inverted in accordance with the method of the invention, and shows the continuity of the coating on predetermined portions of the stem including a lead-in, the fillet through which the lead-in extends, and the flat central portion of the stem;

Figure 7 is a top view of a modified form of

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apparatus for coating an irregularly shaped object; and

Figure 8 is a transverse section along the line 8—8 of Figure 7, and shows detailed structural features of the apparatus of Figure 7.

Referring now in more detail to the drawing, there is shown in Figures 1 and 2 thereof an electron tube stem which may be advantageously coated at predetermined portions thereof by the improved apparatus and method of the invention. The stem includes a glass disc 10 having a flat central portion 11, a plurality of glass fillets 12 disposed in a circular array around the central portion 11, lead-ins 13 to 18a inclusive extending through said fillets, and a peripheral portion 19 to which an open ended glass bulb may be sealed when incorporating the stem in an electron tube. When assembled in an electron tube, the surface 20 of the stem faces the interior of the tube envelope. The portions of the lead-ins 13 to 18a extending upwardly from the fillets 12, as shown in Fig. 2, may be connected either directly or by means of separate leads to electrodes, not shown, included in the finished device. The portions of the lead-ins extending downwardly from the flat portion 11, serve as contact prongs for engaging contact members in a socket (not shown).

When the downwardly extending portions of the lead-ins shown in Fig. 2, are received in a socket, each of such portions of the lead-ins is effectively isolated electrically from the others by the socket structure. However, the portions of the lead-ins extending upwardly from the glass disc 11 of the stem are not isolated electrostatically by normal structural elements of the tube. Consequently, it has been the practice heretofore to utilize a special electrostatic shield between the array of lead-ins and in close proximity to the surface 20 of the stem. In some instances this shield has been in the form of a coating 21, shown in Figure 2. The coating is applied to cover the central portion of the surface 20 between the lead-in array and extends over a portion of the fillet 12 through which a predetermined lead-in, such as lead-in 13, extends. The coating also engages a portion of lead-in 13, so that when this lead-in is connected to a suitable potential source, the coating is given a desired potential for service as an electrostatic shield between the lead-ins.

While other forms of electrostatic shields are known, such as a metal disc resting on or slightly spaced from the surface 20 and electrically connected by means of a lead to a lead-in, such forms require added structural elements which add to the complexity and cost of manufacture of an electron tube.

However, in spite of the advantage of a shield in the form of a coating, this type of shield has not been generally accepted because of difficulty in applying the coating. These difficulties are presented as a consequence of the structural characteristics of the stem to be coated, and because of the critical portions of the stem to which the coating must be limited. Thus, to serve effectively as an electrostatic shield, the coating should be applied to a central portion of the surface 20 spaced from all but one of the lead-ins. The coating should continuously extend from the surface 20 to a side of one of the fillets 12, and to a lead-in such as the lead-in 13 extending through this fillet. The surface to be coated is therefore characterized by appreciable irregularity, including the planar surface 20, a portion of the conical

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surface of the fillet 12 and the cylindrical surface of the lead-in 13 spaced from and extending normally from the surface 20. A further difficulty is occasioned by the fact that the lead-ins are spaced from the upper portions of their associated fillets as shown in Figure 6. This spacing shown at 22 in Fig. 6 occurs unavoidably in sealing the lead-ins through the glass fillets of the stem. The spacing referred to results in the formation of surfaces on the lead-in and within the fillet that are not readily accessible. However, to form a coating that extends continuously from the lead-in to the surface 20, it is necessary that these inaccessible surfaces also be coated.

According to the invention, an apparatus and method are provided for forming a continuous coating extending from the surface 20, to a lead-in such as is shown at 13. The apparatus as shown in Figures 3 and 4 comprises a receptacle 23 having two portions 24, 25, joined by a neck portion 26. Each of the portions 24 and 25 are of equal depth and are adapted to hold a coating supply 27 which may be in the form of a liquid or flowable paste that contains an electrically conducting material such as silver. In portion 25 of the receptacle is disposed a deformable pad 28 made of a felt, rubber sponge or other material adapted to become saturated with the coating material. The pad 28 is suitably supported as by friction in the portion 25 of the receptacle referred to. The height of the pad from the bottom of the receptacle is preferably critically related to the surface of the liquid or paste in the receptacle. This height is preferably such that when the upper surface of the pad engages the surface 20 of the stem, the surface 20 is vertically spaced from the level of the liquid or paste in the receptacle by the dimension of the fillet 12 normally from the surface 20.

When a stem is therefore brought into proper engagement with the coating apparatus, as shown in Figure 5, the surface 20 of the stem engages the upper surface of saturated pad 28 a pressure deformed portion of the pad engages a side of fillet 12, and lead-in 13 extends into the coating material supply 27. A relatively thin coating is thus applied to the surface 20 and the side of the fillet facing inwardly of the fillet array, and a more copious and thicker coating is applied to the lead-in 13.

After the stem has been momentarily placed in the position shown in Figure 5 in relation to the apparatus of the invention, the coating application proceeds further in accordance with steps of the method of the invention. These steps involve raising the stem from the apparatus and inverting the stem so that surface 20 thereof becomes the upper surface. When the stem is inverted in this manner as shown in Figure 6, the coating materials flow downwardly along lead-in 13 and into the space 22 to effectively coat the surfaces defining this space. Since, as shown in Figure 5, the lead-in 13 extends directly into the supply of coating material, a copious amount of the material adheres to the lead-in when it is raised from receptacle 23. This copious amount of material is sufficient not only to coat the surfaces defining the space 22, but an addition to flow downwardly along the thinly coated portion of the conical surface of the fillet 12 until it merges with the coating material 21 on the central flat portion 20 of the stem.

If the consistency of the coating material is relatively thin, very little, if any, of the material will remain on the lead-in 13 above the fillet 12

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as shown in Figure 6. However, because of the space 22 between the lead-in and the fillet, which is filled by coating material during a practice of the method of the invention, the portion of the lead-in defining this space is effectively coated for electrical communication with the coating on the fillet and on the central flat portion of the stem.

The displacement of the fillet 12 from the coating supply as shown in Figure 5 is advantageous in that it presents a thinly coated surface serving as a path for the material flowing downwardly from lead-in 13 as shown in Figure 6. If the fillet were not partially coated during the application of the stem to the apparatus, it would provide no predetermined path for absorbing the coating material flowing downwardly from lead-in 13. Such coating material would therefore be free to flow to the edge 19 of the stem and impair the seal subsequently made to this edge.

It will be apparent from the foregoing therefore, that while it is desirable to copiously coat the lead-in 13 with coating material, to assure a flowing thereof into the space 22 for electrically connecting the lead-in to the coating, an excessive supply of material on the fillet 12 flowing in random paths is undesirable because of its migration to the location at which a seal is to be made. The apparatus of the invention, by selectively causing only the central flat portion of the stem, a predetermined portion of a fillet and the lead-in to contact the coating material, provides a coated surface on the fillet serving as a path to the central portion of the stem and away from the edge 19 for the excess material picked up by the lead-in.

Suitable means, not shown, may be provided for preserving the level of the coating material in the receptacle 23. However, in the absence of such means, the relatively large capacity of the receptacle, particularly the portion 24 thereof, assures a substantially constant level of the coating material during a relatively large number of coating applications, without a continuous or frequent replenishment of the material.

A modified form of apparatus according to the invention is shown in Figures 7 and 8. This form of apparatus includes a housing 29 of elongated tubular form having an inwardly extending flange 30, defining a passageway of smaller transverse dimensions than the space defined by other portions of the housing. One end of the housing is partly closed by a cap 31 having passageway 32 therein in registry with the passageway defined by flange 30. A plunger 33 extends through and is movable longitudinally in passageway 32 in cap 31 and through the passageway defined by flange 30. A portion of the plunger extends externally of the cap 31 and terminates in a knob 34. A nut 35 is threaded to the plunger 33. The nut 35 is urged against the inner face of cap 31 by suitable means such as a spring 36 bearing on a shoulder provided by flange 30. A sleeve 37 is fixed to flange 30 and extends coaxially with plunger 33 and the housing 29. The sleeve serves to maintain the plunger in coaxial relation with housing 29 during travel of the plunger longitudinally within the housing.

At the end of plunger 33 remote from the knob 34 is provided a transverse slot 38 shown in Figure 7 which receives a resilient pad 39 made of a material capable of absorbing coating material. The pad is held in desired position on the slot 38 by means of a pin 40. A portion of the sleeve 37 is cut away to permit the pad to extend laterally

across a wall of the sleeve, as shown at 41 in Fig. 8, for a purpose to be described.

Flat stems are usually made in such a way that all but two of the lead-ins are uniformly spaced from each other. Thus as shown in Figure 1, lead-ins 13 and 13a are further spaced from each other than are the other lead-ins. This larger spacing between lead-ins 13 and 13a provides a reference means both during the operation of sealing the lead-ins to electrodes of the device, as well as for rotationally orienting the device including the stem in a socket.

The spacing between lead-ins 13 and 13a also serves as a reference means in applying the coating referred to to the stem to assure connection of the coating to a predetermined lead-in. Where the coating is applied in accordance with the apparatus and method illustrated in Figures 3, 4, 5 and 6, the operator can easily identify this wider spacing by feel, and by rotating the stem can always orient this wider spacing with a predetermined part of the apparatus, to assure that similarly located lead-ins are coated during several coating operations.

When the coating is applied by means of the apparatus shown in Figures 7 and 8 the locating member 42 thereof enters the space between lead-ins 13, 13a and serves to rotationally orient the stem with respect to the apparatus for application of the coating to a predetermined fillet and lead-in. The locating member 42 is fixed to a portion of housing 29 critically determined by the position of the pad 39 to provide the aforementioned desired orientation of the stem with respect to the pad. The locating member 42 is provided with dimensions for snugly fitting between the farther spaced lead-in 13, 13a. Therefore, the stem and apparatus can be brought into proper relation for application of a coating only when the stem is so oriented that the locating member 42 enters the space between lead-ins 13, 13a.

When the apparatus and stem are so oriented, the portion 41 of the pad first engages the lead-in 13, and in response to pressure, then slides along the fillet 12 until the central portion of the pad contacts the flat central portion of the stem. As a result, the lead-in is engaged by the pad before any of the coating material on the pad is applied to other portions of the stem. Thus the lead-in receives a more copious amount of coating material than said other portions. When using the apparatus shown in Figures 7 and 8, the stem may be held in a suitable jig or holder, not shown, with the surfaces to be coated facing or extending upwardly, and the pad 39 may be brought down on such surfaces. In this event the more copious coating material applied to the lead-in 13 will flow downwardly into the space between the lead-in and its associated fillet along a path determined by the coating on the fillet. Therefore the step of inverting the stem after application of the coating by the apparatus of Figures 3 to 6, is unnecessary when the apparatus of Figures 7 and 8 is used.

To prevent rotation of plunger 33 in housing 29, a pin 43 is provided fixed to the housing and extending into a longitudinal groove 44 in the plunger. This preserves the desired angular orientation of the pad 39 with respect to the locating member 42, and assures that once the locating member enters the space between lead-ins 13, 13a of the stem, the pad will contact and coat a predetermined lead-in 13 and fillet 12.

It will thus be apparent that the present in-

vention provides a novel apparatus and method for coating an irregularly shaped object such as the stem for an electron tube. The apparatus and method of the invention render practicable the use of a coating on an electron tube stem as an electrostatic shield.

What is claimed is:

1. Apparatus for coating predetermined portions only of a flat electron tube stem having a central flattened portion and a circular array of fillets and lead-ins around said central portion, for providing an electrostatic shield between certain of said lead-ins, said apparatus comprising a dish-shaped receptacle for confining a flowable coating material, said receptacle including two spaced portions and a relatively narrow passageway communicating with said spaced portions, and a deformable pad disposed in one of said portions and extending into said material and having a free side adjacent said passageway, said pad being wetted by said material and having an upper flat surface spaced above the level of said material, said upper flat surface having an area when said pad is uncompressed that is substantially equal to the area of said flattened portion of said stem, said pad widening out at its said free side when compressed for engaging said flattened portion and a side only of a predetermined fillet facing inwardly of said array, said passageway being wide enough to receive only one of said lead-ins, whereby a coating is applied only to said flattened portion, to a side of said predetermined fillet, and to the lead-in extending through said fillet, for providing electrical connection between said coating and said lead-in.

2. Apparatus for coating predetermined portions only of a flat stem for an electron tube displaced from the sealing edge of the stem, wherein said stem includes a flattened central portion and circular array of fillets, and lead-ins extending through the stem, said apparatus including a receptacle having an electrically conducting coating material and a deformable pad saturated with said coating material, said receptacle engaging all except a relatively narrow portion of the sides of said pad, whereby said relatively narrow portion only expands outwardly when said pad is compressed, said pad when uncompressed having a free flat surface co-extensive with said flattened portion of said stem, whereby pressure engagement between said flattened portion of said stem and said flat surface of said pad causes said pad to coat said flattened portion, and a side only of one of said fillets, for providing a conducting coating extending from said lead-in to said flat surface and preserving said sealing edge of said stem from said coating material.

3. Apparatus for selectively coating predetermined portions of a flat electron tube stem having a circular array of fillets and lead-ins extending through the fillets, said predetermined portions consisting of the portion of one face of the stem between the fillet array, a side of a predetermined fillet facing inwardly of said array, and a lead-in extending through said fillet; said apparatus comprising a receptacle having side walls adapted to confine a liquid coating material, said side walls defining two end portions of said receptacle and a neck portion between and communicating with said end portions, a pad in one of said end portions in snug engagement with the walls of said one of said end portions and having a free side in registry with said neck portion, said walls having free edges dis-

posed in a common plane, said pad extending outwardly beyond said plane, said pad being adapted to absorb a portion of said coating material and having a surface disposed in a plane parallel to said common plane, said pad being deformable adjacent said surface and at said free side and into said neck portion on application of pressure to said surface thereof, said surface being adapted to engage said portion of one face of the stem for coating said portion, with said lead-in extending into said neck portion and into the coating material therein for receiving a coating therefrom, and said free side of said

pad being adapted to deform on pressure engagement with said portion of said stem face for engaging said side of said predetermined fillet for coating said side.

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