

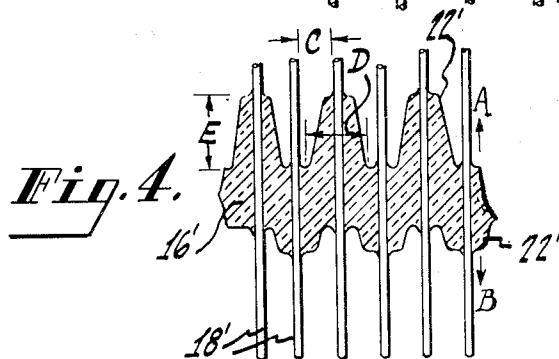
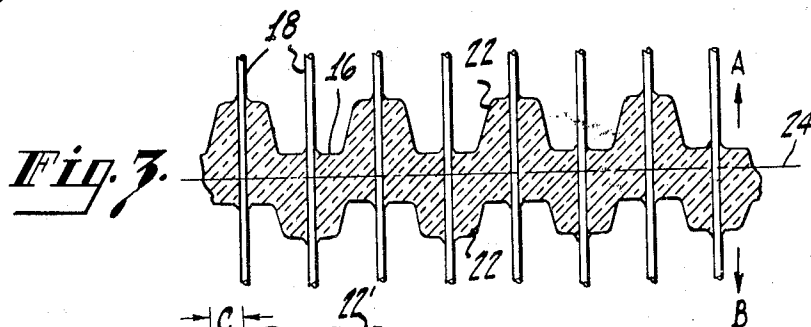
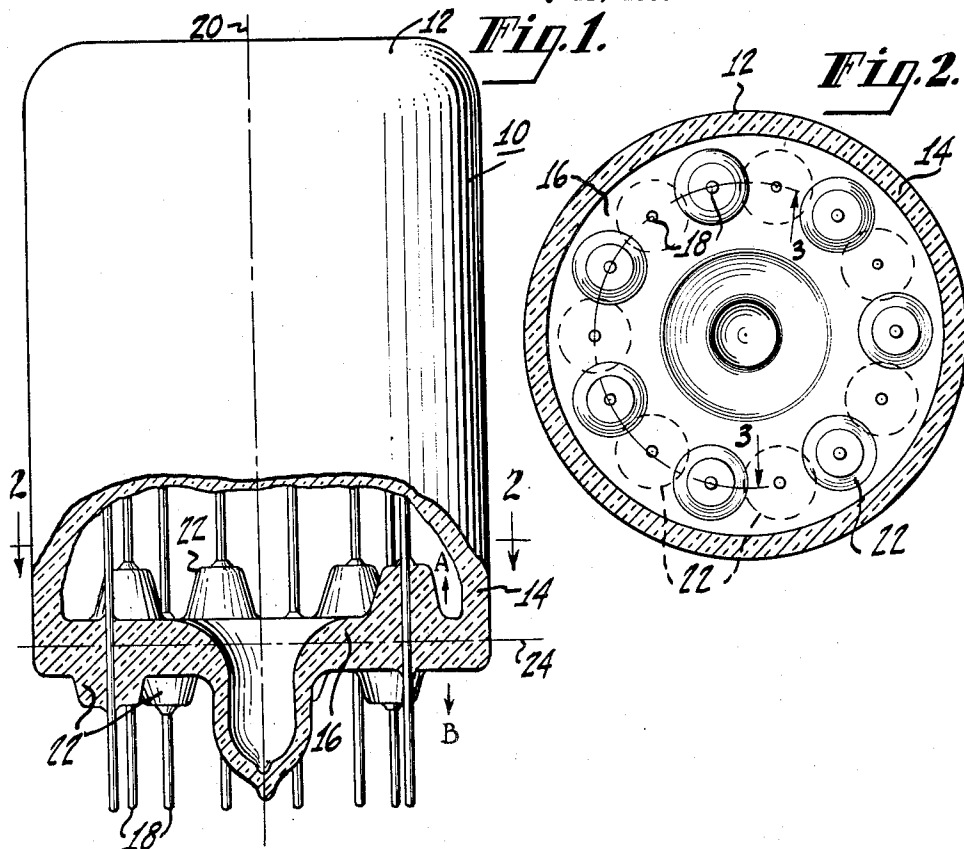
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ELECTRON TUBE STEM

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ELECTRON TUBE STEM

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6 Claims. (Cl. 174—50.61)

This invention relates to improvements in the art of electron tube stems and, though not limited thereto, is herein described as embodied in an electron tube having a relatively great number of lead-in wires passing through a relatively small stem area.

Electron tube stems commonly include a substantially flat body of a moldable material such as glass and have a plurality of lead-in wires extending therethrough. Fillets, or body projections, extend axially of the tube from the body and around a portion of the wires. The body, and the fillets projecting therefrom, are bonded to the lead-in wires in hermetic seals. The fillets serve to increase the electrical leakage path between adjacent wires and to increase the structural strength of the wire-body bond. However, the presence of the fillet material between adjacent wires increases the inter-wire capacitance which proves detrimental in tubes designed for use in applications involving relatively high frequencies.

In some tubes, such as for example photo-multiplier tubes, it is necessary to have a relatively great number of lead-in wires pass through the stem to provide electrical access to all of the electrodes within the tube. At the same time it is desirable that the tube stem, through which the lead-in wires pass, have a relatively small diameter of standard size. Such a stem diameter is desirable in order to effect a compact assembly of the tube and its mating socket and, in order to reduce costs, to use existing tube and socket manufacturing machinery common to receiving type tubes having a relatively small number of lead-in wires.

Accordingly, an object of the invention is to provide an electron tube stem having a relatively small cross-sectional area and a relatively large number of lead-in wires.

Another aim of the invention is to provide an electron tube stem having a relatively large number of lead-in wires and having a relatively long electrical leakage path between adjacent wires.

A further object of the invention is to provide an electron tube stem having a relatively large number of lead-in wires and having a relatively low capacitance between adjacent wires.

The foregoing and related objects are achieved in an electron tube stem which comprises a body and a plurality of wires extending therethrough. Alternate ones of the wires have, on one side of the body, a fillet or body projection extending from the body and along the alternate ones of the wires. The others of the wires are free of fillets on said one side of the body.

The invention is best understood from the following detailed description and drawings wherein like numerals refer to like parts and wherein:

Fig. 1 is a partially cut-away side elevational view of an electron tube embodying the stem of the invention;

Fig. 2 is a sectional view taken through line 2—2 of Fig. 1;

Fig. 3 is a developmental view taken along line 3—3 of the electron tube stem shown in Fig. 2; and

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Fig. 4 is a developmental view of an electron tube stem embodying another aspect of the invention.

Reference is made to Figs. 1 and 2 wherein there is shown a tube 10, which may be a photo-multiplier tube, and embodying the invention. The tube 10 includes an envelope 12 having a cylindrical portion 14 and, sealed thereto, a stem including a substantially flat body 16. The body 16, which is preferably of a moldable insulating material such as glass, has a plurality of lead-in wires 18 extending therethrough in a direction substantially parallel to the axis 20 of the cylindrical envelope portion 14. Fillets or body projections 22 extend axially of the tube from the body 16 and along portions of the wires 18.

The stem of the tube 10, which is usually referred to as a button stem due to its flat, button-like shape, has the glass body 16 and fillets 22 formed from a glass tubular member. The practice usually followed in making a button stem is to dispose a plurality of lead-in wires 18 in a substantially parallel array within the tubular member. The glass tubular member is heated to a soft plastic state and then the softened glass is pressed and formed by dies to the flat button-like stem to seal the glass to portions of the lead-in wires. The dies have apertures within which the wires are disposed. The dies also have cut-away portions around the die apertures to allow glass to flow axially along a portion of each of the wires to form around the wire fillets like those 22 in the drawing.

As is known, the contour of the glass stem body 16 and fillets 22 must be relatively smooth, that is, free of sharp bends and crevasses in order to avoid the creation of points of structural weakness in the stem. The points of structural weakness may, when subjected to thermal or impact shock, result in cracks in the stem. Consequently, the fillets are not disposed in contact with each other, but rather a space is left along the stem body between adjacent fillets. This avoids the creation of crevasses between adjacent fillets at the places between the fillets where the fillets join the stem body.

Since the lead-in wires pass through the center of the fillets and are disposed at a distance from each other which is determined by the distance between the centers of adjacent fillets, and since a space free from fillets must be left between adjacent fillets in order to avoid cracks, the distance between adjacent wires must be greater than the thickness of the fillets (at the fillet portions adjacent to the stem body, distance D in the drawing). Thus, in conventional tube stems, where every wire has a fillet on the same side of the stem body, the minimum distance between adjacent wires is always limited to a distance greater than that represented by the thickness of a fillet (distance D).

As shown in Fig. 3, a developmental view of a portion of the stem of Figs. 1 and 2, the fillets 22 are positioned in a circular array. The fillets of adjacent wires 18 are disposed only on opposite sides of a median plane 24 which is normal to the tube axis 20 and which passes through the body 16. That is, alternate wires 18 of the circular array have, on one side of the body 16, a fillet 22 extending from the body and along the wires. The other wires are free of fillets on the one side of the body. Thus, on the side of the body 16 facing in direction A, that is toward the inside of the tube 10, a fillet 22 extends along only every second lead-in wire. Similarly, on the side of the body 16 facing the opposite direction, B, that is facing away from the tube, a fillet 22 also extends along only every second wire. The use of the afore-described staggered fillet arrangement assures that the axial thickness of the stem at all portions thereof adjacent to the lead-in wire 18 is relatively thick. This gives to the wire-body bond a relatively high structural strength. At the same time the number of fillets 22 on each side of the median plane 24 is reduced. The use of the lesser

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number of fillets 22 means that less fillet material is disposed between adjacent lead-in wires. Since fillet material usually has a higher dielectric constant than that of the medium within and around a tube, the use of a lesser amount of fillet material makes for a lower inter-wire capacitance. Also, as will be explained in connection with Fig. 4, the wires 18 may be disposed at a closer distance to each other than that possible in tubes wherein fillets extend from the stem body along both sides of every wire. Thus a greater number of lead-in wires may be accommodated within a given stem body area.

Fig. 4 illustrates a stem wherein the lead-in wires 18 thereof are disposed at a smaller distance from each other than that in conventional tubes. The distance between adjacent wires 18 is less than that across a fillet 22' at the portion thereof adjacent to the body 16'. Distance C, which represents the distance between adjacent wires 18, is smaller than distance D, the distance across the fillet at the portion of the fillet adjacent to the body 16'. Thus the stem of the invention allows the distance across each of the fillets, at the portion of the fillet adjacent to the stem body, to be at least as great as the distance between adjacent wires. Since the positioning of the wires at a closer distance to each other than is possible in tubes having stems of more conventional design reduces the electrical leakage path between adjacent wires, the loss of electrical leakage path due to the reduction in transverse distance may be made up by a corresponding increasing in axial extent. In other words, the axial distance E of the fillet may be increased by an amount sufficient to provide the necessary leakage path length. If a longer electrical leakage path between adjacent wires is desired within the tube than between adjacent wires outside the tube, the fillets 22' (Fig. 4) on the side of the body 16' facing the inside of the tube, direction A, are made to extend for a greater axial length than the fillets on the side of the body facing the outside of the body, direction B.

While the stem body and fillets have been described with respect to a moldable insulating material such as glass, it will be appreciated that other appropriate insulating materials may instead be used. For example, some of the insulating plastics may be substituted for the glass body and fillets.

What is claimed is:

1. An electron tube stem comprising a body, a plurality of conductors extending therethrough, and a plurality

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of fillets each extending from said body and along one of said conductors, fillets of adjacent conductors being disposed on opposite sides only of a median plane of said body.

2. An electron tube stem comprising a body, a plurality of substantially parallel wires sealed therethrough, and a plurality of fillets each extending from said body and each extending along one of said wires, the distance across each of said fillets at the portion thereof adjacent to said body being greater than the distance between adjacent wires.

3. An electron tube stem comprising a substantially flat body, a plurality of substantially parallel wires extending therethrough, and a plurality of fillets, one of said fillets for each of said wires, separate ones of said fillets extending from said body and along each of said wires, the fillets of adjacent wires being disposed only on opposite sides of a median plane.

4. An electron tube stem comprising a body, a plurality of conductors extending therethrough, and a plurality of fillets, one for each of said conductors, and each fillet extending from said body and along one of said conductors, the distance across each of said fillets at the portion thereof adjacent to said body being at least as great as the distance between adjacent conductors, the fillets of adjacent conductors being disposed only on opposite sides of a median plane.

5. An electron tube stem comprising a substantially flat body, a plurality of substantially parallel wires sealed therethrough, and a plurality of fillets, one of said fillets for each of said wires, separate ones of said fillets extending from said body and along each of said wires, the distance across each of said fillets at the portion thereof adjacent to said body being at least as great as the distance between adjacent wires, the fillets of adjacent wires being disposed only on opposite sides of a median plane passing through said body along the flat dimension thereof.

6. The electron tube stem described in claim 5 and wherein said body and said fillets are of glass.

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