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ELECTRON TUBE AND SOCKET THEREFOR

Filed June 17, 1957

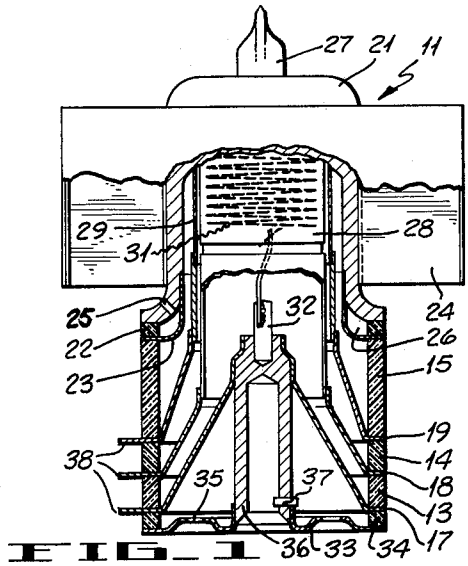


FIG_1

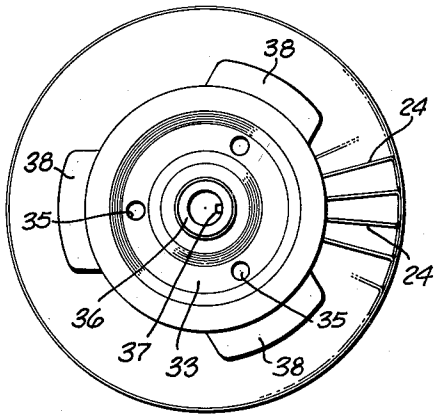


FIG_2

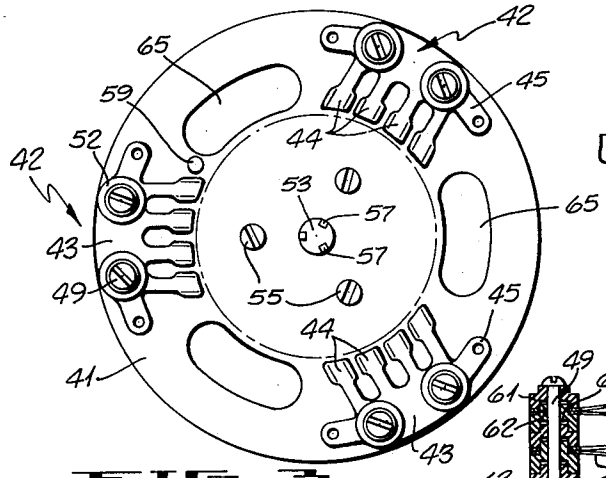


FIG_3

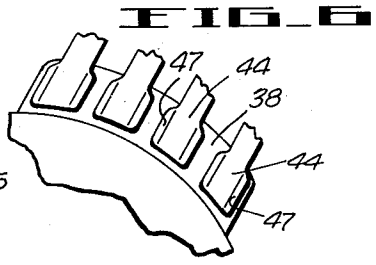


FIG_6

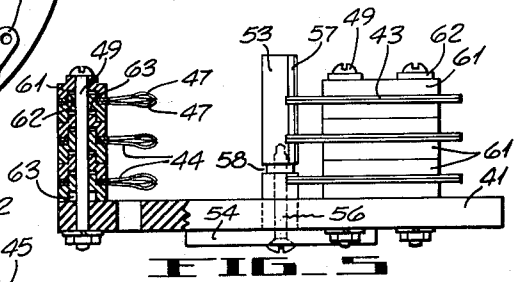


FIG_5

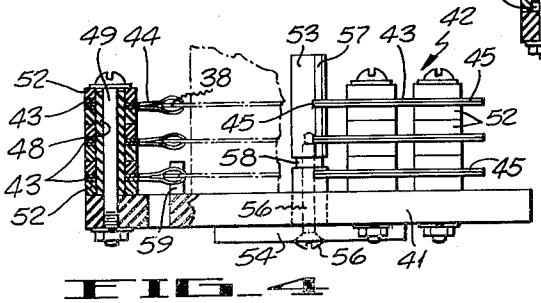


FIG_4

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ELECTRON TUBE AND SOCKET THEREFOR

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This invention relates generally to an electron tube and socket therefor and more particularly to an electron tube of the type having radially extending axially spaced terminal tabs and a socket therefor.

In one type of electron tube the envelope structure comprises ceramic and metallic rings assembled in a stacked relationship with the metal rings functioning both as electrode supports and as terminal members having radially extending axially spaced tabs.

The parts for sockets of the above character have generally been dimensioned for a particular tube, and are not usable in sockets for a different size tube. The socket which accommodates tubes of the above character includes inwardly extending contact fingers and means for holding the same axially spaced to engage the spaced terminal tabs on the tube.

In a tube and socket of the type described, the terminal tabs are spaced around the periphery of the tube and arranged one above the other to form rows. Similarly, the contact fingers on the socket are arranged in rows. Accordingly, when the tube is inserted axially into the socket, the tube must be accurately guided so that the rows of terminal tabs on the tube pass between the rows of contact fingers on the socket.

It is an object of the present invention to provide an improved tube socket.

It is another object of the present invention to improve an electron tube and socket of the type having axially spaced terminal tabs and contact fingers by providing cooperating means located on the tube and socket to guide the tube axially into the socket. An associated object is to provide in conjunction with said guide means a structure which rotationally indexes and axially locks the tube relative to the socket.

It is another object of the invention to provide an electron tube having a rigid and compact structure for supporting a guide or socketing member which will engage a cooperating member on a mating socket.

It is another object of the present invention to provide a tube socket in which the component parts may be used for sockets for a large number of tube sizes.

It is another object of the present invention to provide an improved tube socket of the type having axially spaced contact fingers in which there is provided separate from the contact fingers means for axially guiding a tube into the socket and for holding a tube on its axis during rotation in the socket.

It is another object of the present invention to provide a tube socket of open construction to permit easy passage of air for cooling the associated electron tube and to provide low capacitance between the various socket contacts. An associated object is to provide an electron tube having an envelope particularly designed to permit the free flow of air therealong.

The invention possesses other objects and features of advantage, some of which with the foregoing will be set forth in the following description of the invention. It is to be understood, of course, that the invention is not to be limited to the disclosure of a particular species of the invention, as other embodiments thereof may be adopted within the scope of the claims.

Referring to the drawing:

Figure 1 is essentially a cross sectional view of an electron tube incorporating features of the invention;

Figure 2 is a bottom view of the tube of Figure 1;

Figure 3 is a top view of a tube socket;

Figure 4 is the side elevational view partly in section of the socket of Figure 3 and showing in dot-dash lines a partial view of the tube inserted therein;

Figure 5 is an elevational view partly in section of a modified form of the tube socket; and

Figure 6 is a partial top view showing a tube tab engaged in contact fingers on the socket.

Referring to Figure 1, an electron tube **11** is shown partly in section. The tube **11** may, for example, be a triode in the power tube category having high anode dissipation ratings.

The tube has an evacuated gas-tight envelope of generally cylindrical construction having a side wall comprising three stacked ceramic rings **13**, **14** and **15**, and three metal terminal rings **17**, **18** and **19**. The ceramic rings are preferably of high refractory material such as alumina and are metallized at both ends by a suitable metallizing procedure such as by the molybdenum-manganese powder sintering process. The metallic rings are quite thin and have high electrical conductivity. For example, the rings may be made of copper. The sandwiched parts are brazed together using a high temperature brazing alloy such as copper-gold eutectic or the like.

The metal bonds at the brazed joints form strong mechanical connections and provide a vacuum seal so that the side walls of the envelope form a solid impervious cylinder of rugged construction. The rings provide desired lead-in conductors through the envelope.

A cup-shaped anode **21**, preferably copper, forms the upper portion of the envelope. It is supported upon a ceramic ring **22**. A seal is formed by a metal sealing ring **23** which is brazed at one end to the anode and at the other end to the ceramic rings **15** and **22**. It should be noted that arrangement of sealing ring **23** internally of the envelope permits the free flow of air along the envelope and thus through the cooling fins **24**. It is also pointed out that anode **21** is not bonded to ceramic ring **22** so that it can slide across the ceramic ring during thermal expansion and contraction. Ring **23** is curved so that it can deform to accommodate the slight differential movement of the anode and ceramic rings **15** and **22** during temperature changes. Openings **25** communicate between the space **26** and the surrounding atmosphere whereby pressure is not built up in the space when the tube is placed in an oven to braze together the various parts forming the envelope. The anode **21** carries the exhaust tube **27** which is preferably covered by a suitable protective cap (not shown).

The other electrodes are within the envelope and include cathode **28** and grid **29**. Cathode **28** is heated by the heater filament **31** which has one end supported by a center rod **32** and its other end connected to the cathode **28**. The cathode is preferably of the oxide coated type. The grid **29** is of conventional wire cage construction. All of the electrodes are preferably made coaxial and extend upwardly into the anode **21**. The electrodes are mounted on truncated conical supports which extend inwardly from the associated terminal rings. Preferably, each terminal ring and associated conical support are made as an integral part which may be formed from a sheet of metal.

The lower portion of the tube includes a support member **33** which has its outer surface brazed to a ceramic ring **34**. The ceramic ring **34** is added primarily to reinforce the braze between the ceramic ring **13** and the

terminal ring 17. The ceramic and metallic parts have different coefficients of expansion and without the ring 34 the joint would not be as strong and gas tight. The same result would be achieved by selecting for member 33 a metal having a coefficient of expansion comparable to that of the ceramic. The member 33 and the ceramic ring 34 could form part of the gas-tight envelope. However, a greatly superior structure results if member 33 and ring 34 are not part of the gas-tight envelope since the joint between member 33 and ring 34 is relatively weak compared to the other joints which have ceramic rings on both sides of the metal rings. Accordingly, three holes 35 are provided in member 33.

A guide sleeve or socketing member 36 is adapted to receive a socket guide pin or other mating member, to be presently described. Sleeve 36 is suitably brazed to the support member 33 and extends upwardly into the tube. The upper portion of the sleeve is brazed to the conical extension of terminal ring 17. A guide key is formed by a pin 37 which extends inwardly near the bottom of the sleeve. The key serves to index the tube, as will be presently described. It is apparent that the socketing member is held in the tube with great rigidity because its connection to support member 33 is spaced a substantial distance from its connection to the conical extension of terminal ring 17. Since member 33 is apertured, the lower end of the gas-tight portion of the envelope is formed by the conical extension of ring 17 and the solid upper portion of sleeve 36.

Referring to Figure 2, the terminal rings have outwardly extending tabs designated generally by the reference numeral 38. Each of the rings has a plurality of said tabs spaced circumferentially about the tube. The tabs for the various rings are arranged above one another in vertical rows.

The tube socket includes a support member or platform 41 on which one or more contact stacks 42 are mounted. As seen best in Figures 3 and 4, each of the stacks includes spaced metal contact segments 43 which are extended radially inward to form contact fingers 44. The contact segments include tabs 45 for connection to an external circuit. Contact fingers 44 are arranged one above another to form rows similar to the rows of terminal tabs on the tube. The individual fingers 44 are each flared at their side edges 47 to facilitate entrance of an associated tube tab 38. The contact segments are preferably formed by two sheets of metal placed in abutting contact so that their associated contact fingers will engage both sides of the tube tabs 38.

By suitably choosing the radius on which the inner ends of the contact fingers lie, maximum contact area for a variety of tube diameters may be obtained. For example, it was found that a radius of 1½ inches appeared to be the best compromise for a maximum contact area for tube base diameters ranging from 2 to 6 inches and greater. Referring to Figure 6, a tube terminal tab is shown in engagement with the contact fingers of a contact segment. It is seen that the radius of the tube tab can be varied considerably and yet be engaged by all of the fingers, assuming, of course, that the contact stacks are moved toward or away from the axis of the socket. It should now be understood that this feature of versatility is provided by the use of separate contact stacks. If continuous annular contact rings are used it is not possible to accommodate a wide variety of tube diameters because the contact fingers cannot be moved toward or away from the axis of the socket.

Contact segments 43 include pairs of spaced holes which accommodate insulating sleeves 48. Securing means such as metal bolts 49 pass through the sleeves and secure the stacks 42 to the platform. Insulating spacer segments 52 ride over the insulating sleeves. The segments 52 are placed between contact segments 43 to thereby space the same axially a distance corresponding to the spacing of the terminal tabs of the associated tube.

The combined thickness of each pair of cooperating contact segments 43 is comparable to the thickness of the tube terminal tabs 38. The thickness of the insulating spacers 52 between the contact fingers is equal to the thickness of the ceramic rings 13 and 14 on the tube. The thickness of the lowermost spacer 52 is equal to the combined thickness of support member 33 and ceramic ring 34. In order that a single size of spacers 52 may be used for a plurality of tubes, the tube ceramics 13 and 14 are always designed to be a multiple of the thickness of the standard insulating spacers. For example, all tubes of the type under consideration are designed to employ ceramic rings 13 and 14 which are multiples of say ⅛ inch. The insulating spacers in the socket can then be ⅛ inch so that one spacer size can be used for all tubes by varying the number of spacers used between the contact segments in the socket.

As many stacks 42 as desired may be used. For small low power tubes one stack may be adequate. For larger tubes and greater current demands, additional stacks may be used. Preferably, three stacks 42 are employed to maintain symmetry. However, in low power tubes it may be sufficient to make electrical connection to the tabs 45 in only one stack 42. For higher power tubes electrical connection is made to all of the stacks at least for the contact fingers in one or more planes. This can be facilitated by adding to the socket three wires in the desired plane attached between the tabs 45 of adjacent stacks.

The insulating spacers 52 are subjected to high temperatures and high frequency voltages. They should be capable of withstanding the temperatures and should insulate against the high frequency voltages encountered. For example, spacers 52 made of "Coors AB2" ceramic have proven suitable. Spacers made of "Formica MF66," "Micarta 209" and others may also be suitable. The insulating sleeve 48 may, for example, be made of "Coors AB2" with 1/16 wall which would withstand high frequencies and high voltages. Polystyrene might also be employed. The materials are given for purposes of example and it is not intended to limit the invention in this respect.

For smoothness of installation and to prevent damage to the contact fingers 44 and terminal tabs 38 it is desirable to include a mating member in the socket which cooperates with the socketing member carried in the lower portion of the tube envelope. Preferably, the cooperating members include means for axially locking the tube relative to the socket after it is seated.

In the embodiment illustrated the tube carries a guide sleeve 36 which is provided with a guide key 37. A guide post 53 which is adapted to ride within the sleeve is suitably secured to the socket. A plate 54 is suitably attached to the platform as by screws 55. The guide post is received in the platform and abuts against the plate. A screw 56 engages the post and holds the same against the plate and seated in the platform. The post includes one or more keyways 57 which form indexing slots. The key 37 rides in one of the keyways and indexes the tube. A circumferential groove 58 intersects the keyways 57 adjacent the lower end of the guide post.

It will be noted from Figures 1 and 4 that post 53 extends considerably above the uppermost contact fingers 44 and that key 37 is positioned near the bottom of the tube, so that when the tube is moved toward the socket, key 37 will abut post 53 before the lowermost terminal tab 38 strikes the uppermost contact fingers 44. The tube may then be rotated until key 37 enters one of the keyways 57, at which time the tabs 38 will be automatically offset from the fingers 44 and the tube can be inserted without damaging abutment between the tabs and fingers. When the tube is fully inserted with support member 33 abutting the platform 41, key 37 is positioned in groove 58 and the tube can be rotated for sliding engagement of tabs 38 with contact fingers 44. In

order that the rotation can be handled with certainty and even under conditions of poor visibility, a stop pin **59** is mounted in plate **41** to engage the edge of lowermost tab **38**. In the arrangement shown the tube is obviously rotated clockwise for insertion and counterclockwise for removal. The coaction of the groove and key also serves to lock the tube axially with respect to the socket and thus protects the tabs **38** and fingers **44** from damage when the assembly is subjected to shocks tending to pull the tube axially out of the socket. Post **53** has a sliding fit within sleeve **36** which holds the tube centered during insertion and rotation and prevents wobbling during lateral forces due to shocks.

According to a modified version the contact segments **43** may be axially spaced from one another by means of spacers having a boss and recess design. Thus, referring to Figure 5, spacers **61** each have two bosses **62** on one side and two recesses **63** on the other side. The bosses and recesses are adapted to interfit. The bosses serve to hold the contact segments **43** in alignment and insulated from bolts **49** so that insulating sleeves **48** can be eliminated.

Annular slots or ducts **65** may be formed or cut in the socket base plate **41** preferably between stacks **42** for passage of cooling air, or the air can be blown from the side of the socket and pass between the stacks to strike the tube.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A tube socket for electron tubes of the type having radially extending axially spaced terminal tabs, said socket comprising a plurality of metallic contact segments arranged in stacks spaced around a circle, said contact segments comprising contact fingers extending in a substantially radial direction with respect to said circle and forming the entire number of contact fingers in said socket, insulating means separating the contact segments in each stack from the other contact segments in the same stack, and means holding said contact segments and insulating means together in assembled relation.

2. A tube socket for electron tubes of the type having radially extending axially spaced terminal tabs, said socket comprising a plurality of contact stacks spaced around a circle, each of said stacks comprising a plurality of metallic contact segments and insulating spacer segments sandwiched between said contact segments, said contact segments having contact fingers extending inwardly with respect to said circle and forming the entire number of contact fingers in said socket, means securing together said contact segments and spacer segments in each stack, and means securing said stacks together.

3. A tube socket for electron tubes of the type having radially extending axially spaced terminal tabs and a guide sleeve centrally located at one end, said socket comprising a platform, a guide post secured to said platform, at least one stack of metallic contact fingers supported by said platform and spaced from said guide post, and insulating spacers holding said contact fingers spaced along the axis of said post.

4. A tube socket for electron tubes of the type having radially extending terminal tabs and an axially extending guide element at one end, said socket comprising an elongated guide member, a plurality of contact fingers positioned in rows spaced around a circle concentric with said guide member, said rows extending generally parallel to said guide member, insulating means separating said contact fingers in each row whereby the fingers in each row are spaced longitudinally of said elongated guide member, and means holding said rows of contact fingers in fixed position with respect to each other and in respect to said guide member.

5. A tube socket for electron tubes of the type having radially extending axially spaced terminal tabs and a guide sleeve centrally located at one end, said socket

comprising a platform, a guide post secured to said platform, a longitudinal keyway formed in said post, a circular groove in said post adjacent said platform and intersecting said keyway, contact fingers spaced from said post and spaced along the length of said post, and means connecting said contact fingers to said platform.

6. An electron tube and socket therefor comprising an electron tube having an envelope comprising axially spaced metallic terminal rings with ceramic rings sandwiched therebetween, tube elements mounted on said terminal rings internally of said envelope, terminal tabs on said terminal rings and projecting outwardly of said envelope, terminal tabs on adjacent terminal rings being aligned in rows, said tube having a guide sleeve mounted at one end thereof and extending along the axis of the tube, and a tube socket having a guide post receivable coaxially within the guide sleeve and serving to guide the tube as it is seated in the socket, a contact stack having contact fingers spaced from said guide post and aligned in a row corresponding to said row of terminal tabs, and means holding said contact stack and guide post in fixed position relative to each other, said guide sleeve and said guide post being rotatable with respect to each other when engaged, the radial distance between the inner edge of said contact fingers and the axis of said guide post being less than the radial distance between the outer edge of said terminal tabs and the axis of said guide sleeve whereby said tabs may be rotated into overlapping engagement with said fingers when said tube is in said socket.

7. An electron tube and socket therefor comprising an electron tube having a generally cylindrical envelope comprising axially spaced metallic terminal rings with ceramic rings sandwiched therebetween, tube elements mounted on said terminal rings internally of said envelope, terminal tabs on said terminal rings and projecting outwardly from the sides of said envelope, terminal tabs on adjacent terminal rings being aligned in a row, said tube having a guide sleeve mounted at one end thereof and extending along the axis of the tube, a guide key carried in the lower end of said sleeve and projecting inwardly into the sleeve, a tube socket comprising a platform, a guide post having one end attached to said platform and receivable within said guide sleeve to center said tube as it is seated in the socket, at least one longitudinal keyway formed in said post and serving to receive said guide key to index the tube and prevent rotation thereof as it is seated in the socket, a plurality of contact fingers supported on said platform and spaced from said guide post, said plurality of contact fingers being aligned in a row corresponding to said row of tabs on said tube, said key and keyway being so oriented with respect to said terminal tabs and contact fingers that said tabs and fingers are out of engagement when said key is in said keyway, and a peripheral groove communicating with said keyway adjacent said one end of said guide post permitting said key to leave said keyway by following said groove to permit rotation of the tube within the socket, said groove being oriented with respect to said contact fingers to insure proper engagement of said tabs and contact fingers upon rotation of said tube.

8. A tube socket for tubes of the type having radially extending axially spaced terminal tabs and guide means mounted at one end thereof, said socket comprising a platform, a plurality of contact stacks spaced around a circle on said platform, said stacks including metallic contact segments having inwardly extending contact fingers, insulating spacer segments disposed between said contact segments in each stack, a metallic bolt extending through said stacks and securing the same to the platform, insulating means separating said bolt from said contact segments, and guide means disposed at the center of said circle and extending upwardly into said socket,

said guide means adapted to mate with the tube guide means to guide the tube into the socket.

9. A socket as claimed in claim 8 in which said insulating means comprise a sleeve surrounding each of said bolts, said contact segments having bores therein receiving said sleeve.

10. A socket as claimed in claim 8 in which said insulating means comprise bosses on one side of said spacer segments, said bosses fitting within mating recesses on the opposite sides of adjacent spacer segments, said bolts passing through said bosses, and said contact segments having bores therein through which said bosses pass.

11. An electron tube having a gas-tight envelope comprising alternate insulating and metal rings bonded together in stacked relationship, the end ring at one end of said gas-tight envelope being one of said metal rings, a guide sleeve attached to said end metal ring coaxially thereof and extending outside said envelope, an outside insulating ring bonded to said end metal ring externally of said gas-tight envelope and coaxial with said sleeve, a support ring bonded to said outside ring, said support ring being attached to the end of said guide sleeve outside said envelope, the connection between said guide sleeve and said end metal ring being spaced a substantial distance from said end of said sleeve; said end metal ring, said outside insulating ring, said support ring and said guide sleeve forming a wall structure enclosing an annular space; and an aperture in said wall structure opening said space to the outside of the tube.

12. An electron tube having a gas-tight envelope comprising alternate insulating and metal rings bonded together in stacked relationship, the end ring at one end of said gas-tight envelope being one of said metal rings, a guide sleeve having one portion thereof attached to said end ring coaxially of the end ring, and support means connected between said end ring and the end of said guide sleeve outside of said envelope, said one portion of the sleeve being spaced a substantial distance along the sleeve from said end of the sleeve.

13. An electron tube having a gas-tight envelope comprising alternate ceramic and metal rings bonded together in stacked relationship, the end ring at one end of said gas-tight envelope being one of said metal rings, said end ring extending within the envelope in a conical shape having its apex directed toward the other end of the envelope, an elongated guide sleeve attached to said end ring adjacent the apex thereof and extending outside said envelope, an outside ceramic ring bonded to said end metal ring externally of said gas-tight envelope, a metal support ring bonded to said outside ceramic ring, said support ring being attached to the end of said guide sleeve outside said envelope, the connection between the sleeve and said end metal ring being spaced a substantial distance from said end of said guide sleeve, and at least one aperture in said support ring between the guide sleeve and said outside ceramic ring.

14. An electron tube having a gas-tight envelope comprising alternate insulating and metal rings bonded together in stacked relationship, electrodes in said envelope, certain of said electrodes being connected to certain of said metal rings, at least one of said metal rings having circumferentially spaced terminal tabs extending outwardly from said envelope, said tabs being flattened in a plane transverse to the tube axis for engagement with coacting contacts in a cooperating tube socket on rotation of the tube about its axis, and a guide sleeve extending inwardly of the tube structure to receive a supporting post in the socket, the bore of said guide sleeve being disposed substantially normal to the plane of said one metal ring and opening to the outside of the tube at one end of the tube, whereby said tube can be rotated on the post about the axis of said sleeve to cause said terminal tabs to rotate into engagement with contacts in the socket.

15. An electron tube and socket therefor comprising an electron tube having an envelope comprising spaced metallic rings with ceramic rings sandwiched therebetween, tube elements mounted on said metal rings internally of the envelope, terminal tabs on said metal rings projecting outwardly of said envelope, and a socket comprising metal contact members having contact fingers projecting inwardly into contact with said terminal tabs, and insulating spacer segments positioned between said contact members, the thickness of said tabs being equal to the thickness of said contact members positioned between adjacent insulating spacer segments, all of said insulating spacer segments having the same thickness, and the thickness of said ceramic rings being a whole multiple of the thickness of said insulating spacer segments greater than one.

16. An electron tube having an envelope comprising spaced metallic rings with ceramic rings sandwiched therebetween, tube elements mounted on some of said metal rings internally of the envelope, terminal tabs on some of said metal rings projecting outwardly of said envelope, an anode for said tube comprising an end portion abutting one of said ceramic rings, one of said metallic rings being a sealing ring having its outer peripheral portion sandwiched between said one ceramic ring and the next adjacent ceramic ring, said sealing ring being attached at its inner peripheral portion to said anode internally of said envelope, and metallic bonds joining all of said metallic rings and the adjacent ceramic rings.

17. An electron tube and socket therefor comprising an electron tube having an envelope comprising spaced metallic terminal rings with ceramic rings sandwiched therebetween, tube elements mounted on said terminal rings internally of said envelope, terminal tabs on said terminal rings projecting outwardly of said envelope and being aligned in a row, a tube socket comprising contact fingers aligned in a row corresponding to said row of terminal tabs, a post guide member received within a sleeve guide member, said tube being rotatable about the axis of said guide members to engage said tabs with said contact fingers, one of said guide members being a part of said tube, and the other guide member being a part of said socket.

18. An electron tube having an envelope comprising alternate ceramic and metal rings bonded together in stacked cylindrical relationship, an anode at one end of said tube, a guide sleeve on the tube axis at the other end of said tube and connected to a first one of said metal rings, a second one of said metal rings being positioned nearer said anode than said first ring, said guide sleeve being attached to said second ring at a position spaced toward said anode from the connection between said sleeve and said first ring, a third one of said metal rings being positioned nearer the anode than said second ring, a cathode mounted on said third metal ring, a heater for said cathode, tabs on said second and third metal rings projecting outside the envelope and forming terminals respectively for said heater and said cathode.

References Cited in the file of this patent

UNITED STATES PATENTS

1,578,707	Beck	Mar. 30, 1926
1,721,971	Pascucci	July 23, 1929
1,727,826	Harris	Sept. 10, 1929
2,022,964	Jones	Dec. 3, 1935
2,477,940	Ready	Aug. 2, 1949
2,644,907	Drieschman	July 7, 1953
2,701,869	Hobson	Feb. 8, 1955
2,808,528	Martin	Oct. 1, 1957
2,814,750	Polese	Nov. 26, 1957
2,859,372	Stangl	Nov. 4, 1958

OTHER REFERENCES

Kohl: "Materials Technology for Electron Tubes," Reinhold Pub. Corp., 1951, pages 418 and 419.