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(73) Proprietor: **English Electric Valve Company Limited**
106, Waterhouse Lane
Chelmsford, Essex, CM1 2QU (GB)

(73) Proprietor: **THE SECRETARY OF STATE FOR DEFENCE**
Whitehall
London SW1A 2HB (GB)

(72) Inventor: **King, Robin Charles Moorhouse**
Proctors Farm Beauchamp Roding
Ongar Essex, CM5 0PJ (GB)
Inventor: **Esterson, Maurice**
30 Rainsford Avenue
Chelmsford Essex, CM1 2PJ (GB)
Inventor: **Clarke, John, Dr.**
154 Lower Howsell Road
Malvern Link Worcestershire WR14 1DL (GB)

(74) Representative: **Rouse, David George**
General Electric Company p.l.c. Central Patent Dept. (Chelmsford Office) Marconi Research Centre West Hanningfield Road
Great Baddow Chelmsford Essex CM2 8HN (GB)

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Description

This invention relates to linear beam tubes and more particularly to the electron guns of such tubes.

The electron gun end of a typical linear beam tube is shown in Figure 1 of the accompanying drawings.

Referring to Figure 1 the glass or ceramic envelope of the linear beam tube is represented at 1, the cathode of its electron gun is represented at 2 and the anode of its electron gun is represented at 3. The anode 3 is mounted directly upon the first pole piece 4 of a focussing structure at the entrance of a slow wave structure (not represented but to the right as viewed) of the linear beam tube. Commonly but not necessarily this first pole piece 4 constitutes also an end wall of the first cavity of the slow wave structure. In this case the anode 3, mounted as it is on the first pole piece 4, is held at ground potential and the length of the main cathode voltage insulator (i.e. the length L of the envelope 1 electrically between the cathode 2 and the pole piece 4) is determined by the voltage stand-off requirements external to the tube. Where the tube operates in air the length L requires to be longer than would be the case if the gun end of the tube were to be immersed in a dielectric liquid.

With the configuration of Figure 1, during high voltage arcs occurring between the cathode 2 and anode 3 these electrodes are prone to damage and for this reason the known configuration shown in Figure 2 of the accompanying drawing has found some favour by virtue of the protection that may be afforded to the electrodes in the face of such high voltage arcs.

Referring to Figure 2 in this case the anode electrode 3 is isolated from the pole piece 4 and is mounted upon a metal cylinder 5 which cylinder is in turn supported between two insulating lengths of envelope 1′ and 1″ which are each of length equal to L.

A flange 6 by which the cylinder 5 is mounted, and which is sandwiched between the two lengths of insulator 1′ and 1″, forms an electrical connection for the anode 3. Between the electrical connection formed by flange 6 and earth is an external limiting resistor 7. In practice, and as shown, the end of the resistor 7 remote from the flange 6 is grounded by being attached to the first pole piece 4. In some cases grounding is effected not via the first pole piece 4 but via a current sensor.

With the construction of Figure 2, during normal operation the anode 3 is held close to ground potential since there is negligible anode current drawn. However when an anode to cathode arc occurs a relatively large current flows through the limiting resistor 7 which charges the anode up to cathode potential, thus causing the arc to be extinguished. In this case the anode is at a potential other than ground potential only during such arcs.

Whilst the tube illustrated by Figure 2 is, as regards cathode to anode arcs, a "protected" tube as opposed to the tube illustrated by Figure 1 which is an "unprotected" tube, a serious disadvantage arising from the construction of Figure 2 is the added length of insulating envelope wall, i.e. the two portions 1′ and 1″, between the cathode mount and the first pole piece 4-effectively double that of the construction illustrated by Figure 1. Whilst this added length is in itself undesirable there is in consequence also a tendency for the gun to be the more susceptible to vibration. Such vibration can give rise to electrical noise which is a serious limitation in some systems.

The present invention seeks to provide an improved linear beam tube in which the above difficulty is reduced.

According to this invention an electron beam tube comprises an electron gun having at one end thereof a cathode and at the other end thereof an anode, said anode being mounted adjacent to but isolated from an end wall of a structure downstream of said gun and wherein said anode is supported by means of folded mounting means comprised of a first part extending back from said anode towards the cathode end of said gun and a second part extending forward from the end of said first part remote from said anode towards said end wall, one of said two parts being of insulating material and having provided on a surface thereof a limiting impedance which is electrically in series in a path between said anode and an external termination which in operation may be grounded (directly or indirectly e.g. via a current sensor) whereby to permit said anode to tend to charge towards cathode potential if an anode to cathode arc occurs.

Said structure may for example be a focussing structure; wave propagating structure; an electron beam tunnel or the like depending upon the type of linear beam tube to which the invention is applied.

The end of said second part adjacent said end wall may be attached to said end wall or carried from the envelope of said tube at a position adjacent said end wall.

Commonly said end wall will be the first pole piece of a focussing structure, in which case where the end of said second part adjacent to said end wall is attached to said end wall said pole piece may comprise said external termination.

Preferably said first and second parts of which said folded mounting means is comprised are, in any plane transverse to the beam axis over the major portions of their lengths, generally circular in cross section and co-axial with said beam axis.

Both of said parts may overall be generally cylindrical and united at their ends remote from said end wall and said anode by flange means or at least one of said two parts may be generally conical.

In one embodiment of the invention said first part comprises a ceramic tubular member and said second part comprises a conical metallic member which has a flange at its end remote

from said first part which flange extends through the envelope of said tube adjacent said end wall.

Preferably with a construction as last described said limiting impedance is provided on an internal surface of said tubular member comprising said first part, with one end in contact with said anode and the other in contact with said conical metallic member.

In another embodiment of the invention said first part comprises a metallic tubular member co-axially within a ceramic tubular member which comprises said second part, said ceramic tubular member being attached at one end to said end wall and the end of said metallic tubular member remote from said anode being flanged with its flange attached to the end of said ceramic tubular member remote from said end wall.

Preferably with a construction as last described said limiting impedance is provided on an external surface of said tubular member comprising said second part with one end in contact with said flange and the other electrically connected to said external termination.

Said limiting impedance may comprise deposited resistive material preferably deposited within a groove in the surface of that member upon which said limiting impedance is provided as aforesaid.

The invention is further described with reference to Figures 3 and 4 of the accompanying drawing which illustrates two embodiments of the present invention.

In Figures 3 and 4 like references are used for like parts in Figures 1 and 2.

Referring to Figure 3 as will be seen the anode 3 is isolated from the pole piece 4 and is mounted upon a ceramic cylindrical member 8 which extends back towards the cathode end of the electron gun.

The cylindrical ceramic member 8 is supported by means of a flanged conical metallic member 9 which surrounds the cylindrical member 8. One end 10 of the conical member 9 is fixed to the end of the cylindrical ceramic member 8 remote from the anode 3. The other flanged end of the conical member 9 extends through the envelope 1 of the tube to form an external termination 11. The length of envelope between the flange 11 and the mount of the cathode 2 is equal to L.

On the interior surface of the cylindrical ceramic member 8 is deposited within a groove 12 resistive material forming the required limiting impedance. The deposited resistive material extends beyond the groove so that one end 13 of the limiting impedance is in electrical contact with the anode 3 and the other end extends over the end of the cylindrical ceramic member 8 to contact end 10 of the conical metallic member 9. As shown, the resistive material is deposited in the base of the groove 12 and extends only partly up the side walls of the groove.

Thus the limiting impedance is again in series in a path between the anode 3 and the external termination 11. If this termination is grounded then as already described with reference to Figure 2, arcs occurring between the cathode 2 and the anode 3 may be suppressed. It will be noted however that the overall length of the gun section of the protected tube illustrated by Figure 3 corresponds more closely to that of the electron gun of the unprotected tube of Figure 1 than to the lengthy gun section of the protected tube of Figure 2.

Because the limiting impedance operates in a vacuum within the tube envelope the length of ceramic required to hold off the voltage is less than is the case for the resistor 7 of Figure 2.

Referring to Figure 4, the anode 3 is again isolated from the pole piece 4. Anode 3 is mounted upon a generally cylindrical metallic member 14 which extends back from the anode 3 towards the cathode end of the electron gun.

Member 14 is co-axially within a cylindrical ceramic member 15 which is mounted at one end on the pole piece 4 and extends back therefrom towards the cathode end of the electron gun.

The end of member 14 remote from the anode 3 is flanged with its flange 16 attached to the end of the ceramic member remote from the pole piece 4.

Passing through the envelope wall 1 adjacent to, but spaced from, the pole piece 4 is an annular metallic member 17 which extends inwardly towards the tube axis to contact the cylindrical ceramic member 15. Member 17 provides an external termination.

On the exterior surface of cylindrical ceramic member 15 is deposited within a groove 18, resistive material forming the required limiting impedance. The deposited impedance formed again extends, beyond the groove, from the flange 16 of cylindrical metallic member 14 to member 17 forming said external termination.

Thus again the limiting impedance is in series in a path between the anode 3 and the external termination formed by member 17 and if the last mentioned is grounded then again as already described with reference to Figure 2 arcs occurring between the cathode 2 and the anode 3 may be suppressed.

Claims

1. An electron beam tube comprising an electron gun having at one end thereof a cathode (2) and at the other end thereof an anode (3), said anode being mounted adjacent to but isolated from an end wall (4) of a structure downstream of said gun and wherein said anode is supported by means of folded mounting means comprised of a first part (8, 14) extending back from said anode towards the cathode end of said gun and a second part (9, 15) extending forward from the end of said first part remote from said anode towards said end wall, one of said two parts being of insulating material and having provided on a surface thereof a limiting impedance which is electrically in series in a path between said anode and an external termination (11, 17) which in operation may be grounded whereby to permit

said anode to tend to charge towards cathode potential if an anode to cathode arc occurs.

2. A tube as claimed in claim 1 and wherein the end of said second part (15) adjacent said end wall (4) is attached to said end wall.

3. A tube as claimed in claim 1 and wherein the end of said second part (9) adjacent said end wall is carried from the envelope of said tube at a position adjacent said end wall.

4. A tube as claimed in any of the above claims and wherein said end wall (4) is the first pole piece of a focussing structure.

5. A tube as claimed in claim 4 as dependent upon claim 2 and wherein said pole piece comprises said external termination.

6. A tube as claimed in any of the above claims and wherein said first and second parts of which said folded mounting means is comprised are, in any plane transverse to the beam axis over the major portions of their lengths, generally circular in cross section and co-axial with said beam axis.

7. A tube as claimed in claim 6 and wherein both of said parts are, overall, cylindrical and united at their ends remote from said end wall and said anode by flange means.

8. A tube as claimed in claim 6 and wherein both of said parts are, overall, generally cylindrical or at least one of said two parts is generally conical the two parts being united at their ends remote from said end wall.

9. A tube as claimed in any of claims 1 to 6 and wherein said first part (8) comprises a ceramic tubular member and said second part (9) comprises a conical metallic member which has a flange at its end remote from said first part which flange extends through the envelope (1) of said tube adjacent said end wall (4).

10. A tube as claimed in claim 9 and wherein said limiting impedance is provided on an internal surface of said tubular member comprising said first part (8), with one end in contact with said anode (3) and the other in contact with said conical metallic member (9).

11. A tube as claimed in any of claims 1 to 6 and wherein said first part (14) comprises a metallic tubular member co-axially within a ceramic tubular member (15) which comprises said second part, said ceramic tubular member being attached at one end to said end wall (4) and the end of said metallic tubular member remote from said anode being flanged with its flange (14) attached to the end of said ceramic tubular member remote from said end wall.

12. A tube as claimed in claim 11 and wherein said limiting impedance is provided on an external surface of said tubular member comprising said second part (15) with one end in contact with said flange (16) and the other electrically connected to said external termination (17).

13. A tube as claimed in any of the above claims and wherein said limiting impedance comprises deposited resistive material.

14. A tube as claimed in claim 13 and wherein said resistive material is deposited in a groove (12) in the surface of that member upon which said limiting impedance is provided.

Patentansprüche

1. Elektronenstrahlröhre mit einer Elektronenkanone, die an ihrem einem Ende eine Katode (2) und an ihrem anderen Ende eine Anode (3) besitzt, wobei die Anode benachbart zu, jedoch isoliert von einer Endwand (4) einer Struktur abstromseitig zur Kanone befestigt ist, und wobei die Anode mittels eines gefalteten Befestigungsmittels abgestützt ist, das aus einem ersten, sich von der Anode zu dem Katodenende der Kanone zurückerstreckenden Teil (8, 14) und einem zweiten, sich von dem von der Anode abgelegenen Ende des ersten Teiles nach vorne zu der Endwand hin erstreckenden Teil (9, 15) besteht, wobei eines der beiden Teilen aus isolierendem Material ist und eine an einer Oberfläche desselben vorgesehene Begrenzungsimpedanz enthält, die elektrisch in Reihe in einem Weg zwischen der Anode und einem Außenanschluß (11, 17) liegt, der im Betrieb geerdet sein kann, um der Anode eine Ladungstendenz zum Katodenpotential hin zu erlauben, falls ein Anoden/Katoden-Bogen auftritt.

2. Röhre nach Anspruch 1 und bei der das der Endwand (4) benachbarte Ende des zweiten Teils (15) an der Endwand angebracht ist.

3. Röhre nach Anspruch 1 und bei der das der Endwand benachbarte Ende des zweiten Teiles (9) von dem Mantel (1) der Röhre an einer der Endwand benachbarten Stelle gehalten ist.

4. Röhre nach einem der vorangehenden Ansprüche, und bei der die Endwand (4) das erste Polstück einer Fokussierungsstruktur ist.

5. Röhre nach Anspruch 4 in Abhängigkeit von Anspruch 2 und bei der das Polstück den äußeren Anschluß bildet.

6. Röhre nach einem der vorangehenden Ansprüche, und bei der das erste und das zweite Teil, aus denen das gefaltete Befestigungsmittel besteht, in irgendeiner Ebene quer zur Strahlachse über den Hauptteil ihrer Längen von allgemein kreisförmigem Querschnitt und koaxial zur Strahlachse sind.

7. Röhre nach Anspruch 6 und bei der beide Teile insgesamt zylindrisch und an ihren von der Endwand und der Anode abgelegenen Enden durch Flanschmittel vereinigt sind.

8. Röhre nach Anspruch 6 und bei der diese beiden Teile insgesamt allgemein zylindrisch sind, wobei mindestens eines der beiden Teile allgemein kegelförmig ist und die beiden Teile an ihren von der Endwand abgelegenen Enden vereinigt sind.

9. Röhre nach einem der Ansprüche 1 bis 6 und bei der das erste Teil (8) ein rohrförmiges Keramikelement und das zweite Teil (9) ein kegelförmiges Metallelement umfaßt, das an seinem von dem ersten Teil abgelegenen Ende einen Flansch besitzt, der sich benachbart zur Endwand (4) durch den Mantel (1) danz an einer Innenfläche des rohrförmigen Elementes vorge-

sehen ist, das das erste Teil (8) bildet, wobei ein Ende mit der Anode (3) und das andere mit dem kegelförmigen Metallelement (9) in Kontakt ist.

11. Röhre nach einem der Ansprüche 1 bis 6 und bei der das erste Teil (14) ein rohrförmiges Metallelement koaxial innerhalb eines rohrförmigen Keramikelementes (15) umfaßt, welches das zweite Teil bildet, wobei das rohrförmige Keramikelement an einem Ende an der Endwand (4) angebracht ist und das von der Anode abgelegene Ende des rohrförmigen Metallelementes mit einem Flansch versehen ist, wobei sein Flansch (14) an dem von der Endwand abgelegenen Ende des rohrförmigen Keramikelementes angebracht ist.

12. Röhre nach Anspruch 11 und bei der die Begrenzungsimpedanz an einer Außenfläche des rohrförmigen Elementes vorgesehen ist, welches das zweite Teil (15) bildet, mit einem Ende in Kontakt mit dem Flansch (16) und dem anderen elektrisch mit dem Außenanschluß (17) verbunden.

13. Röhre nach einem der vorangehenden Ansprüche und bei der die Begrenzungsimpendanz abgeschiedenes Widerstandmaterial umfaßt.

14. Röhre nach Anspruch 13 und bei der das Widerstandsmaterial in einer Nut (18) in der Oberfläche des Teiles abgeschieden ist, auf dem die Begrenzungsimpedanz vorgesehen ist.

Revendications

1. Tube à faisceau électronique, comprenant un canon à électrons qui possède une cathode (2) à une extrémité et une anode (3) à son autre extrémité, l'anode étant montée voisine mais isolée d'une paroi d'extrémité (4) d'une structure en aval du canon, et dans lequel l'anode est supportée au moyen d'un dispositif de support replié, constitué d'une première partie (8, 14) s'étendant vers l'arrière à partir de l'anode, en direction de l'extrémité à cathode du canon, ainsi que d'une seconde partie (9, 15) s'étendant vers l'avant à partir du bout éloigné de l'anode de la première partie, en direction de ladite paroi d'extrémité, l'une des deux parties étant en matériau isolant et portant à sa surface une impédance de limitation qui est disposée électriquement en série dans un circuit entre l'anode et une borne externe (11, 17) pouvant être reliée à la terre pendant le fonctionnement, afin de créer une tendance à la charge de l'anode dans le sens de son rapprochement du potentiel cathodique s'il se produit un arc de l'anode à la cathode.

2. Tube selon la revendication 1 et dans lequel le bout de la seconde partie (15) voisin de la paroi d'extrémité (4) est attaché à cette paroi.

3. Tube selon la revendication 1 et dans lequel le bout de la seconde partie (9) voisin de la paroi d'extrémité est porté par l'enveloppe (1) du tube à un endroit voisin de cette paroi.

4. Tube selon l'une quelconque des revendications précédentes et dans lequel la paroi d'extrémité (4) est la première pièce polaire d'une structure de focalisation.

5. Tube selon la revendication 4 dépendante de la revendication 2, dans lequel la pièce polaire forme la borne externe.

6. Tube selon l'une quelconque des revendications précédentes et dans lequel la première et la seconde partie, dont est constitué le dispositif de montage replié, possèdent une forme générale circulaire, en section droite, dans n'importe quel plan transversal à l'axe du faisceau, sur les majeures portions de leurs longueurs, et sont coaxiales à cet axe du faisceau.

7. Tube selon la revendication 6 et dans lequel les deux parties possèdent une forme générale cylindrique et sont reliées l'une à l'autre à leurs bouts éloignés de la paroi d'extrémité et de l'anode par un dispositif formant une bride.

8. Tube selon la revendication 6 et dans lequel les deux parties possèdent une forme générale cylindrique, au moins l'une des deux parties est généralement conique et les deux parties sont reliées par leurs bouts éloignés de la paroi d'extrémité.

9. Tube selon l'une quelconque des revendications 1 à 6 et dans lequel la première partie (8) est une pièce tubulaire en céramique et la seconde partie (9) est une pièce métallique de forme conique et dont le bout éloigné de la premiére partie porte une bride qui s'étend au travers de l'enveloppe (1) du tube près de la paroi d'extrémité (4).

10. Tube selon la revendication 9 et dans lequel l'impédance de limitation est prévue sur une surface interne de la pièce tubulaire formant la première partie (8), de manière qu'une extrémité de l'impédance soit en contact avec l'anode (3) et que son autre extrémité soit en contact avec la pièce métallique (9) de forme conique.

11. Tube selon l'une quelconque des revendications 1 à 6 et dans lequel la première partie (14) est une pièce métallique tubulaire disposée coaxialement dans une pièce tubulaire (15) en céramique, laquelle forme la seconde partie, la pièce tubulaire en céramique étant attachée à un bout à la paroi d'extrémité (4) et le bout de la pièce métallique tubulaire éloigné de l'anode étant pourvu d'une bride (16) attachée au bout de la pièce tubulaire en céramique éloigné de la paroi d'extrémité.

12. Tube selon la revendication 11 et dans lequel l'impédance de limitation est prévue sur une surface externe de la pièce tubulaire formant la seconde partie (15), de manière qu'une extrémité de l'impédance soit en contact avec la bride (16) et que son autre extrémité soit reliée électriquement à la borne externe (17).

13. Tube selon l'une quelconque des revendications précédentes et dans lequel l'impédance de limitation est formée par un dépôt de matériau résistant.

14. Tube selon la revendication 13 et dans lequel le matériau résistant est déposé dans une rainure (12) ménagée dans la surface de la pièce sur laquelle est prévue l'impédance de limitation.

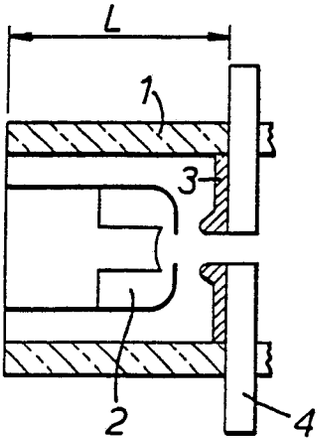

FIG. 1.

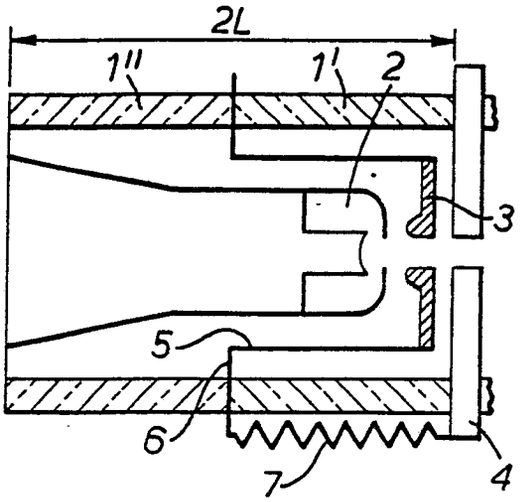

FIG. 2.

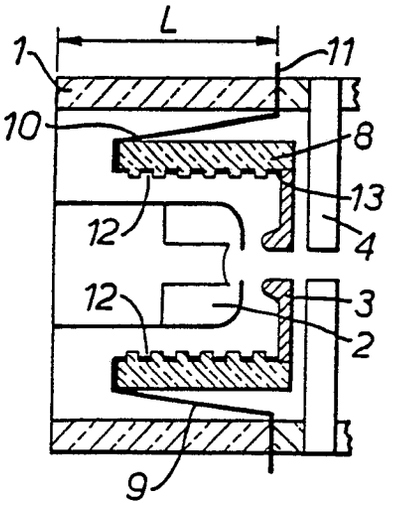

FIG. 3.

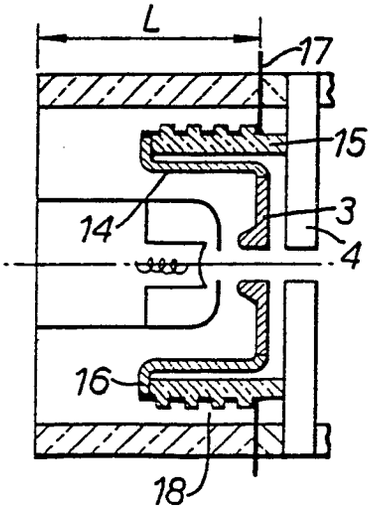

FIG. 4.