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ELECTRON DISCHARGE DEVICE

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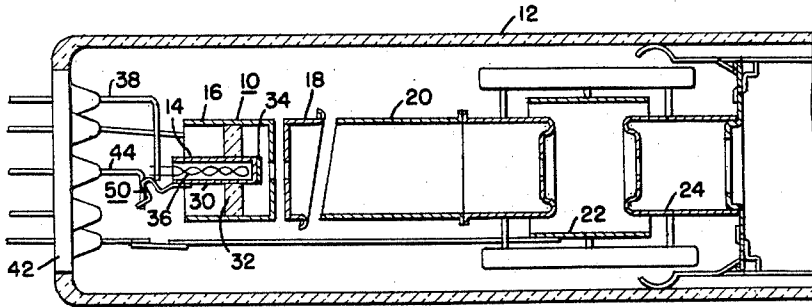


Fig. 1.

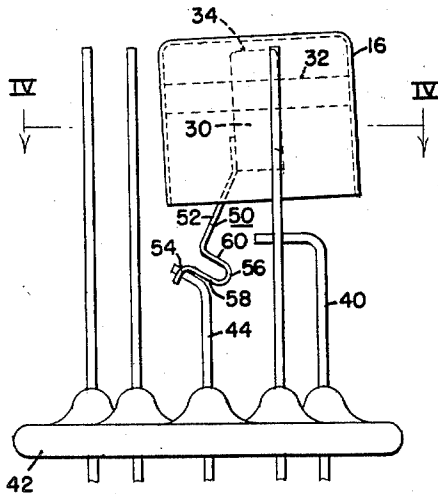


Fig. 2.

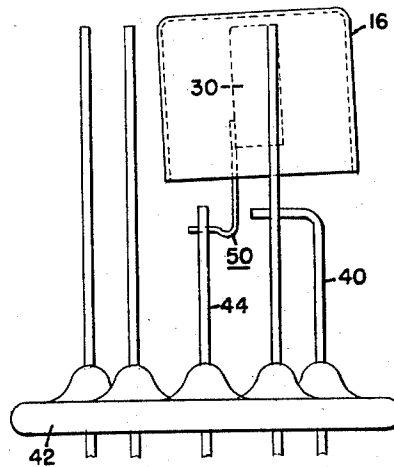


Fig. 3.

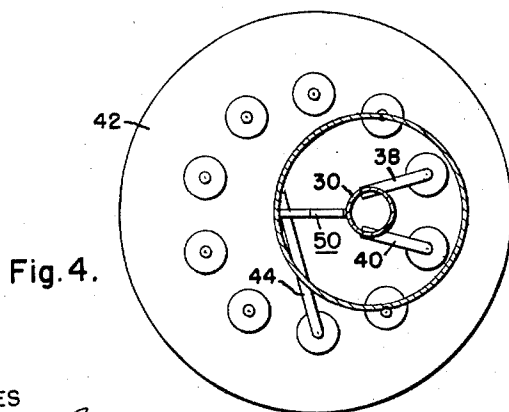


Fig. 4.

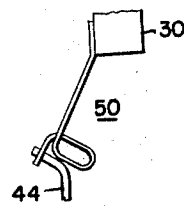


Fig. 5.

WITNESSES

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ELECTRON DISCHARGE DEVICE

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This invention relates to an electron discharge device, and more particularly to connecting means between heated electrodes and lead-in members.

One particular type of electron discharge device in which this invention is particularly useful is a cathode-ray tube. One of the most serious problems found in a cathode-ray tube is in the breakage of the cathode tab utilized to electrically connect the lead-in to the cathode electrode of the electron gun. This is of such a serious nature that it is quite common in the tube industry to provide two cathode tabs to insure a reasonable probability that one of the tabs will withstand 6,000 heating-cooling cycles.

Failure of the cathode tab is primarily due to repetitive stresses of thermal expansion and contraction acting within a portion of the tab which at its high operating temperature has a relatively low fatigue endurance strength. Further, the high operating temperature of this portion of the cathode tab causes progressive metallurgical crystalline grain growth and consequent reduction of endurance strength. The operating temperature of the cathode may be 1400 to 1500 degrees F., while the temperature of the lead-in may be of the order of 500 degrees F. at the point to which the cathode tab is connected.

One attempt to solve this problem has been to place a loop or bend in the cathode tab so as to take care of at least some of the expansion problem within the cathode tab since the lead-in and cathode are relatively fixed members. This type of solution is illustrated in Fig. 3 of the drawing. This solution has not completely solved the problem and it is accordingly, an object of this invention to provide an improved cathode tab.

It is another object to provide a cathode tab adaptable for use in securing an electrode to a lead-in member.

It is another object to provide a flexible connecting member between the two substantially fixed members without danger of failure due to thermal expansion of the connecting member.

It is another object to provide an electrical connector between two members to withstand repeated heat cycles. These and other objects are effected by my invention as will be apparent from the following description taken in accordance with the accompanying drawing throughout which like reference characters indicate like parts, and in which:

Figure 1 is a view of an electron gun positioned within the neck of a cathode-ray tube incorporating the teachings of my invention;

Fig. 2 is an enlarged view of the cathode tab assembly illustrated in Fig. 1;

Fig. 3 is an enlarged view of a cathode tab assembly of prior art construction;

Fig. 4 is a transversed section view taken along the lines IV—IV of Fig. 2, and

Fig. 5 illustrates a modified cathode tab.

Referring to Fig. 1, there is shown an electron gun 10 of conventional design mounted within the neck 12 of a cathode-ray tube. The electron gun 10 consists of a

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cathode assembly 14, a control grid 16, a screen grid 18, a first anode 20, a focus electrode 22 and a second anode 24 in the order named.

The cathode assembly 14 consists of a tubular member 30 positioned within the tubular skirt portion of the control grid 16. The tubular cathode or sleeve 30 is retained within the control grid 16 by means of at least a ceramic collar 32. The cathode sleeve 30 is closed at the end thereof adjacent the control grid diaphragm and is provided with an electron emissive coating 34. A heater element 36 is inserted into the open end of the sleeve 30 and is connected to lead-in members 38 and 40 through the glass button stem 42 in the neck of the tube. The element 36 provides means of heating the electron emissive surface 34 of the cathode. A lead-in 44 is also provided for the cathode 14 and is sealed through the glass bottom 42 of the tube neck 12 and is bent at substantially a right angle after entering the tube neck as illustrated in Figs. 2 and 4.

The cathode tab 50 is connected between the cathode sleeve 30 and the lead-in 44 as illustrated in the drawings and is attached to the cathode sleeve 30 and the lead-in 44 by a welding operation to provide good electrical connection. The cathode tab is a small ribbon-like member having a cross section of about .005 inch x .020 inch and of a suitable electrically conductive material such as nickel. One end of the ribbon-like tab 50 is attached to the lower portion of the cathode sleeve 30. One side, that is one of the two larger area surfaces of the tab 30, is welded to the outer surface of the sleeve 30. The ribbon-like cathode tab 50 is connected at the opposite end to the lead-in 44. The tab 50 consists of a straight portion 52 adjacent to the sleeve 30 and which extends away from the sleeve 30 at a slight angle with respect to the axis of the sleeve 30, and a portion 54 adjacent to the lead-in 44. The portion 54 is an aid locating the point that is in line with portion 52. It is important that the straight portion 52, the connecting point to the sleeve 30 and the connecting point to the lead-in be in substantially a straight line.

A loop or U-shaped portion 56 is provided intermediate the connecting ends of the tab 50 and is perpendicular to the sides of the ribbon-like tab 50. The U-shaped member consists of two legs 58 and 60, the leg 58 connecting to the portion 54 and the leg 60 connecting to the straight portion 52. The legs 58 and 60 are substantially parallel and the leg 58 is slightly longer than the leg 60.

Referring to Fig. 2, it can be seen that the straight portion 52 of the tab 50 adjacent the sleeve 30 extends along a straight line substantially in line with the connecting point of the tab 50 to the lead-in member 44. It should also be noted that the leg 60 of the loop 56 nearest the sleeve 30 is shorter than the leg 58 of the loop 56 nearest the lead-in member 44. This is important in view of the fact that the operating temperature at the point of connection with the lead-in 44 is perhaps 500° F. while the point where the loop 56 connects with the straight portion 52 of the tab 50 may be of a temperature of the order of 800° F. By providing the proper length of the leg members 58 and 60 of the loop 56, it is possible to cause substantially equal expansion of the two leg members 58 and 60, and thereby substantially negate any flexing of the tab 50 adjacent the sleeve 30 when the tab 50 is heated. The linear expansion of the tab portion 52 adjacent the sleeve 30 is absorbed by the loop portion 56 without imposing excessive compressive stress on the member. By providing that the straight portion 52 of the cathode tab 50 connected to the sleeve 30 is directed such that it points substantially at the point of fastening at the opposite end of the cathode tab 30 to the lead-in 44, the

stresses and strains of the two connecting points are substantially reduced.

In Fig. 5, there is illustrated a closed loop type structure which is the mechanical equivalent of the open loop illustrated in Fig. 2.

The resulting configuration has been found to improve greatly the life of the cathode-ray tube and has substantially removed the difficulty of breakage of the cathode tab connected between the sleeve and the lead-in member. It may be desirable to utilize two tabs in order to provide longer life.

While I have shown my invention in only one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible to various other changes and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. In combination, a cathode electrode, a lead-in member and a connecting tab welded to said cathode and said lead-in, said tab member being of more flexible material than said cathode and lead-in, said lead-in and said cathode substantially fixed with respect to each other, said tab having a U-shaped portion intermediate the ends thereof, said tab having two straight portions connecting the U-shaped portion of the tab to said cathode and said lead-in, respectively, said straight portions of said tab lying in substantially a straight line.

2. In combination, a cathode electrode, a lead-in member and a connecting tab welded to said cathode and said lead-in, said connecting tab being of a flexible material comprised of at least a straight portion connected to said

cathode and a loop portion intermediate said lead-in and said cathode, said straight portion directed so as to lie substantially in line with the connecting point of said tab to said lead-in member.

3. In combination, an electrode member, a lead-in member for said electrode and a connecting tab member welded to said electrode and said lead-in, said tab consisting of a flexible ribbon like member, said tab having a U-shaped portion in said tab intermediate the connecting ends of said tab, said tab having two straight portions connecting the U-shaped portion of the tab to said electrode and said lead-in, the straight portion connected to said electrode longer than the other said straight portion said U-shaped portion of such dimensions that the leg nearest said electrode is shorter than the leg member nearest said lead-in so that upon heating the total expansions of each of the two leg portions of the U-shape portion are substantially equal.

4. In combination, a cathode electrode, a lead-in member and a connecting tab welded to said cathode and said lead-in, said connecting tab being of a flexible material comprised of at least a straight portion connected to said cathode and a loop portion intermediate said lead-in and said cathode, said straight portion lying in line with the connecting points of said tab to said cathode and said lead-in.

References Cited in the file of this patent

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