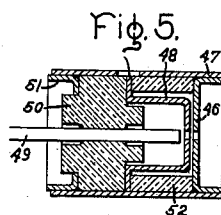
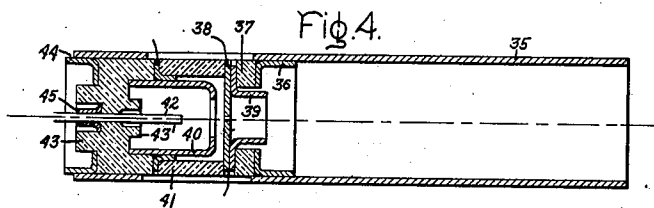
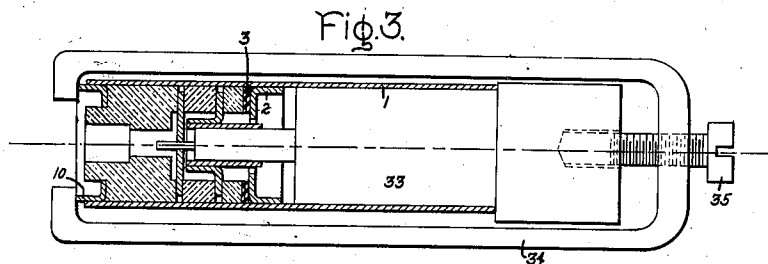
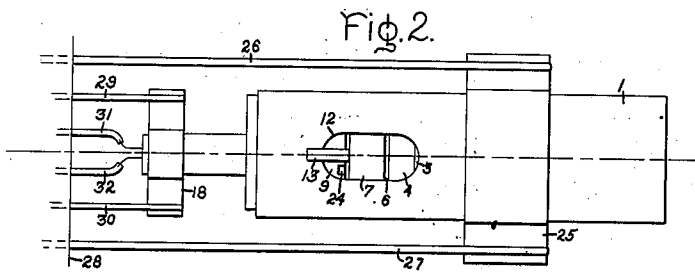
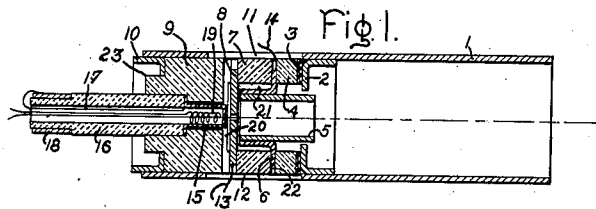


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CATHODE RAY TUBE

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CATHODE RAY TUBE

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2 Claims. (Cl. 250—163)

This invention relates to improvements in the construction of cathode ray devices, such as cathode ray tubes for oscillographic or television purposes, electron microscopes, iconoscopes and the like. Its object is to provide a novel way of constructing electron guns and electron lens systems, satisfying the requirements of high accuracy in adjustment and alignment, high insulation, good vacuum qualities and cheap manufacture.

According to the invention the electrodes of which the electron gun and/or lens system are composed are mutually insulated and maintained in predetermined spaced relationship by means of ceramic insulating parts which are held together and thereby support the electrodes in their desired relationship. The insulated parts together with the electrodes are preferably held within a metal tube which may form one of the electrodes of the gun and/or lens system. The ceramic parts may be constituted of fired steatite. The leakage paths, which lead from one electrode to the other along the surface of an insulator are rather short, the leakage is kept, however, at a very low value by protecting at least one section of said leakage path from products evaporated or sputtered during the operation of the device. According to a further feature of the invention the axial distances of the electrodes are determined by the accurately moulded or machined ceramic parts, the alignment, however, is obtained during the assembling process by gauges and maintained by friction.

In order that the nature of the invention may be more readily understood reference is directed to the following description of the accompanying drawing, in which Figs. 1 and 2 show longitudinal section and view respectively of an electron gun constructed according to the invention; Fig. 3 shows the process of assembling and aligning said electron gun; Fig. 4 is an application of the new method of construction to another type of electron gun; and Fig. 5 shows the application to an electron microscope.

Fig. 1 is a section of an electron gun for a cathode ray tube. In this figure, 1 is a tube, preferably of non-magnetic material, which forms the second anode of the gun and which contains the following elements: The apertured flanged metal disc 2, the mica washer 3, the steatite ring 4, the first anode, consisting of a tubular part 5 and of a flare 6, the steatite ring 7, the modulating electrode 8, which is a disc with a small aperture, the steatite part 9 and the apertured flanged disc 10. All these parts

are introduced into the tube and pressed axially together by the two metal discs 2 and 10, the flanges of which are welded to the tube 1. The tube 1 is provided with two windows 11 and 12, through which the leads 13 and 14 for the modulating electrode and first anode respectively are led out. All the parts enumerated form together a unit. The cathode 15 is fitted into this so that it has an accurately fixed position and is yet easily removable. It consists of a hollow cylinder closed at one end and flanged outwardly at the other, the flange being located between part 9 and the ceramic tube 16. The cathode lead 17 is connected with the sleeve 18 around the outer end of tube 16. The cathode is fitted with a heater 19, preferably of the double helical type.

The leakage paths between the electrodes in this construction are extremely short, some of them of the order of only 1 mm. Yet almost perfect insulation has been obtained by the following measures; the ceramic part 9 is fitted with a small recess 20, with a depth of only a few tenths of a millimeter. This has proved a perfectly reliable means for ensuring leakage resistances of more than 100 megohms between cathode 15 and modulating electrode 8, even in the hot state and in prolonged operation. The evaporation and sputtering products can not penetrate into this recess even in several thousand hours of operation, just by reason of its small depth which offers a high diffusion resistance and forces them to condense near the inner edge. Similarly the tubular slit 21 ensures good insulation between grid and anode. The path between second and third anode is very short, but it has been found that it can be as small as 0.5 mm. and yet ensures perfect insulation for a very long time as the narrow slit 22 remains permanently clean. If, e. g., in the course of assembling or by previous handling these surfaces are not quite clean, they can be cleaned once for all by applying after assembling high voltages to the electrodes and burning the impurities out. The sharp corner 23 on the outside of part 9 has been found very efficient for reducing the leakage between cathode and second anode, presumably by its shadowing action for impurities.

Fig. 2 is a view of the same gun. It shows the window 12 and the parts which are visible through it. It shows also the transverse slot 24 machined into part 9, which may serve for visibly checking the correct distance of cathode and modulating electrode or grid, and also enables

a magnified shadow projection of the clearance cathode-grid to be thrown on a screen. This figure shows also a convenient way of mounting the gun. The sleeve 25 is welded to the tube 1 and to the leads 26, 27, sealed into the stem 28. The sleeve 18 which supports the cathode is welded to the leads 29, 30, whereas the heater leads are welded to the leads 31, 32. If the leads 26, 27 are cut, the gun can be removed and if desired used again with another cathode.

Fig. 3 shows the process of assembling the gun above described. After having welded in the apertured disc 2, the parts are put into the tube 1 one by one and aligned on the gauge 33, which fits exactly into the tube 1 and into the apertures of the electrodes. Finally the apertured disc 10 is introduced and the whole pile of parts compressed by means of the clamp 34, and the screw 35. The disc 10 is welded into 1 whilst under pressure. Now the clamp can be removed and the whole gun is fired at a suitable temperature, e. e. 900° in hydrogen or in vacuo. The mica disc 3 expands considerably during the firing process and keeps all parts solidly locked.

Soapstone turned and fired at 900° for about 15 minutes has proved a very satisfactory material as a ceramic insulator. It becomes sufficiently hard, whereas its shrinkage is negligible. It is possible, therefore, to assemble the gun with unfired soapstone insulators and fire them only together with the whole gun, which means considerable cheapening of the manufacture.

Fig. 4 shows the new method of construction according to the invention applied to another type of electron gun. 35 is a metal tube serving as second anode, 36 an apertured disc welded into it, 37 a washer of ceramic material, 38 the first anode with a small aperture, having a tubular extension 39 which shields the ceramic part 37. In this construction as in all the others described in this specification, care is taken that insulating surfaces shall be either shielded by metal parts or sufficiently removed from the electron beam, so that charges which might accumulate on them may not interfere with the focussing fields. 40 is the modulating electrode or grid which is spaced from the first anode by a tubular ceramic part 41. The cathode 42 is introduced through a bore in the ceramic part 43. By stepping this bore and by providing a sharp edged ridge 43' care is taken to reduce leakage between cathode and modulating electrode. The parts named are finally pressed together by means of an annular disc 44, welded under pressure into the tube 35. The cathode can be easily removed from the gun. Its axial spacing is fixed by the eyelet 45 welded to it and fitting into a recess of the part 42.

The construction according to the invention is eminently suited for the objectives of electron microscopes, in which accurate centering is essential and the distances of the electrodes are extremely small. Fig. 5 shows the objective of an electron microscope. The apertured disc 46, welded into the tube 47 is the anode of the objective, 48 is the first electrode. Both have very small apertures and their mutual distance must

be kept very small. They are accurately spaced by the ground ceramic tube 52. The expansion coefficients of 47 and 48 are preferably matched in such a way as to keep the distance between 46 and 48 constant. The cathode 49, which is to be investigated is introduced through the ceramic part 50 and is preferably made movable in order to obtain variable magnification, as known per se. This system is centred preferably on a lathe, before welding in the ring 51 which keeps all parts in position.

Electron guns and other lens systems according to the invention have been extensively tested and it has been found that in spite of the small distances and of the continual deposition of evaporation products of the cathode the leakage resistances could be kept as high as 1000 megohms for practically unlimited times.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electrode assembly for cathode ray devices comprising an elongated metal tube, a block of insulating material interfitting within one end of the tube, a cathode supported by the insulating block and having an electron emissive surface thereof exposed toward the interior of the tube, a first apertured electrode element positioned in operative alignment with the cathode within the tube and adapted to serve as a grid for controlling the emission from the said surface of the cathode, the said electrode element being maintained in spaced relation to the cathode by abutment with the said insulating block, a second apertured electrode element positioned within the tube in alignment with the said cathode and adapted to serve as an accelerating anode, an insulating spacer separating the said first and second electrode elements, and means within said elongated metal tube for clamping the said insulating block, the electrode elements and the spacers in mutually abutting engagement.

2. An electrode assembly for cathode ray device comprising an elongated mounting tube, a block of insulating material interfitting within one end of the said tube, a cathode supported by the insulating block and having a substantially planar electron emissive surface directed axially of the tube, an apertured disk electrode positioned in operative alignment with the cathode and adapted to serve as a grid for controlling the emission from the said surface of the cathode, the said electrode being maintained in fixed spaced relation to the cathode by abutment with the said insulating block, a tubular electrode positioned in alignment with the aperture in said grid electrode and adapted to serve as an accelerating anode, said tubular electrode being provided with a laterally extending flange, an insulating spacer interfitting within said tube between said flange and said disk electrode for maintaining a fixed spatial relationship between such electrode and the adjacent extremity of the said tubular electrode, and means within the said mounting tube for clamping the insulating block, the electrodes and the spacer in mutually abutting relation.

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