May 28, 1940. H. KNIEPKAMP 2,202,588

ELECTRODE SYSTEM FOR CATHODE RAY TUBES

Filed June 22, 1938

Fig.1

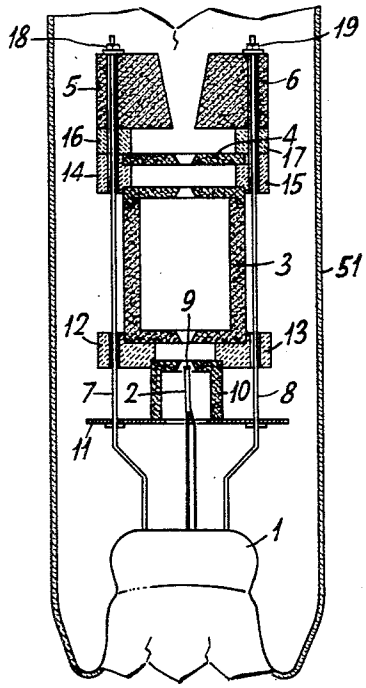


Fig.4

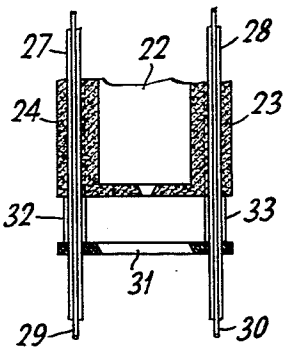


Fig.6

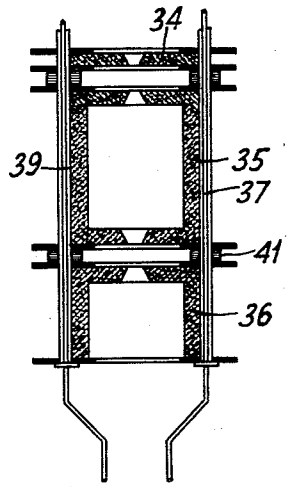


Fig.5

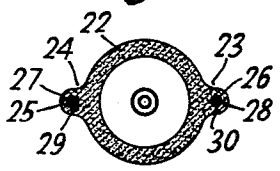


Fig.7

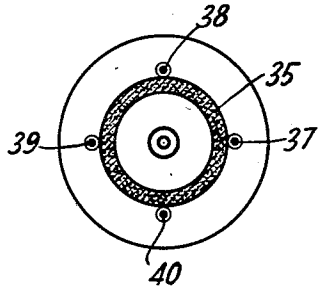


Fig.2

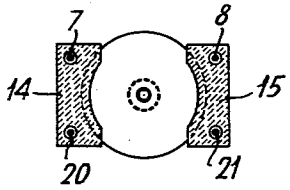


Fig.8

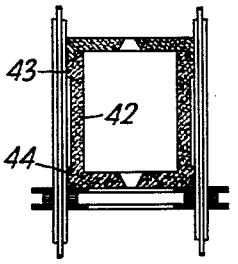


Fig.10

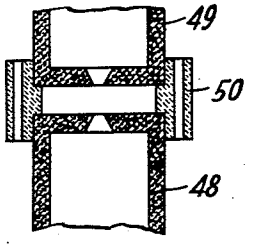


Fig.3

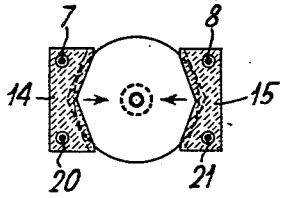
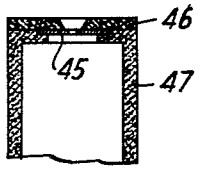


Fig.9



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ELECTRODE SYSTEM FOR CATHODE RAY TUBES

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2 Claims. (Cl. 250—162)

Electrode assemblies for cathode ray tubes comprise as a rule quite a number of electrodes serving for various purposes such as electron emission, acceleration of the emitted charge carriers, focusing thereof and the deflection of the cathode ray pencil. The assembling and the supporting of these electrodes is difficult and requires a good deal of precision of workmanship. The chief demand is that the electrodes should be exactly centered. While this is a task in itself, there is another difficulty in the electrode systems heretofore employed in which at least a part of the electrodes consists of sheet material. These sheets being of fairly large area and size are subject to warping when heated for outgassing. No matter how carefully the electrode system has been adjusted and alined, dissymmetry will often arise as a result, which may produce annoying disturbances during the actual operation of the cathode ray tube.

Now, these drawbacks are avoided by the present invention. According to the invention, at least those electrodes contained in a cathode ray tube which are substantially unloaded are made from graphite. This material offers the advantage that it will not warp when subjected to an outgassing treatment, in fact, it will perfectly preserve its shape. At the same time, it is readily worked, for it can be fashioned in a lathe, for example, into a perfectly cylindrical or cone-shaped body. This advantage is not present where the electrodes are made of sheet or plate material as heretofore customary. In the working of solid metal with turning or similar tools, the resulting thickness of the electrode body will always be comparatively great, and as a result the electrode is heavy. If low-weight electrodes are desired, they must be bent out of sheet material, and this is always attended with a certain lack of precision. In the making of electrodes from graphitic material, the difficulty of undue weight is absent since this material has a very low specific gravity. Hence, comparative heaviness in dimension is no disadvantage and is permissible without the electrode system becoming unduly heavy as a result.

Outgassing of graphitic electrodes such as those here disclosed is effected by the application of heating from the outside while the tube is still connected to the evacuating pump. In order to save the glass envelope of the vessel or tube, the heating usually is not pushed beyond the 400-degree mark. In fact, this outgassing temperature is perfectly adequate inasmuch as the unloaded or but feebly loaded electrodes in operation will never be heated to such high temperatures so that whatever gases may stay occluded therein will be readily kept inside the graphite. However, it is also quite readily possible to outgas graphite by the use of high-frequency currents. In this case it is advisable to coat the graphite with a poor heat radiation layer in order to prevent strong heat radiation.

In the drawing,

Figures 1 and 6 show alternate forms of assembled cathode ray tube electrodes constructed in accordance with this invention, and

Figures 2 through 5 and 7 through 10 show various modified forms of electrodes.

Referring to Figure 1, element 1 denotes a press or squash which supports an electrode system comprising a cathode 2, an accelerator electrode, an anode 4 and two deflector plates 5 and 6. The entire assembly is carried by four metallic rods 7, 8, 20, 21, which are sealed in the press 1. The indirectly heated cathode 2, which is coated at its end 9 with electron-emissive substance, is surrounded by a Wehnelt cylinder or shield 10 made of graphite. This shield is borne upon a mica disc 11, the latter being secured, in turn, upon the support rods 7, 8, 20 and 21. The accelerator electrode 3, which also consists of graphite, is insulated from the shield 10 and spaced apart therefrom by two annular ceramic bodies 12 and 13. Two similar elements 14 and 15 (also of ceramic) are interposed between the accelerator electrode 3 and the anode or gun 4. Placed over the anode 4 are the two insulation discs 16 and 17 upon which the two deflector plates 5 and 6 are supported. By the aid of two screws 18 and 19 the entire electrode system is held tensionally together.

Figure 2 shows another form of ceramic spacer pieces. In this figure the anode and parts of the system surmounting it must be imagined to be removed. The two ceramic bodies 14 and 15, as will be seen, are supported by the four metallic rods 7, 8, 20 and 21. The two ceramic parts could also be of a form as shown in Figure 3, and this facilitates their manufacture to a great extent.

Figures 4 and 5 show another example of the form of the electrodes and the supporting thereof. The electrode 22 has flange-like lugs 23 and 24 which have holes 25 and 26 through which the supporting rods 29, 30 lined with tiny insulation sleeves 27 and 28 are passed. The electrode 22 is spaced apart from the next electrode 31 by a small insulation tubelet or bushing.

Another simple form of supporting for the electrode system according to this invention is illus-

trated in Figure 6. For the sake of clarity of illustration an exemplified embodiment resembling that in Figure 1 is chosen. The electrodes 34, 35 and 36 are tensionally held between mica platelets or discs. The latter have holes through which the four supporter rods 37, 38, 39, 40 are passed. These rods bear insulation sleeves, and arrangements are made so that the insulation sleeves engage the electrodes from the outside and hold them in position. Spacing is also here insured by insulation sleeves 41 placed about the support rods. Since it is comparatively difficult to make the electrodes fit exactly in the space between the supporting rods, surfaces are provided on the electrodes against which the supporting rods come to bear. This is shown by way of example in Figure 8. An electrode 42 is furnished with assembly (fitting) surfaces 43 and 44. When introducing the electrodes in their supportings the necessary amount of material can be removed from these two surfaces for proper fit.

Occasionally it is of advantage to make the inner part of the diaphragm in the form of a metallic sheet; this insures sharp edges which will be less liable to be damaged. Metallic diaphragms of this nature, as shown in Figure 9, could be readily combined with the graphite electrodes here disclosed. For instance, the diaphragm 45 could be tensionally held between the two graphite parts 46 and 47. These graphite parts are again held in a manner as hereinbefore described. Another advantageous way of securing the graphite electrodes on the ceramic supporting parts is feasible by the means of screws as illustrated in Figure 10. The two graphite electrodes 48 and 49 are screwed into the ceramic ring 50 from both ends.

Although in the exemplified embodiments hereinbefore described cylindrical electrode assemblies are shown, it will be evident that any other electrode forms could conveniently be made of graphite, and especially in these the ease of working of graphite will be of advantage.

I claim:

1. In a cathode ray tube in which a gun structure is provided for generating a beam of electrons, said gun structure including a cathode, a control electrode and a plurality of accelerating and focusing electrodes, one of said last named electrodes comprising a carbon cylindrically shaped member and a pair of centrally perforated planar carbon end members, said members being provided with diametrically opposed unitary extensions, said extensions being provided with openings parallel with the axis of the cylindrical member, and insulating means for maintaining said ends of members in contact with the ends of the cylindrical member with the perforations of the end members in alignment with the axis of the cylindrical member.

2. In a cathode ray tube in which a gun structure is provided for generating a beam of electrons, said gun structure including a cathode, a control electrode and a plurality of accelerating and focusing electrodes, one of said last named electrodes comprising a carbon cylindrically shaped member and a pair of centrally perforated planar carbon end members, said members being provided with diametrically opposed unitary extensions, said extensions being provided with openings parallel with the axis of the cylindrical member, another of said accelerating electrodes being in the form of a centrally perforated planar carbon member and insulating means for maintaining said end members in contact with the ends of the cylindrical members and said other accelerating electrode spaced from one of said end members with the perforations of the planar members in alignment with the axis of the cylindrical member.

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