

April 16, 1940.

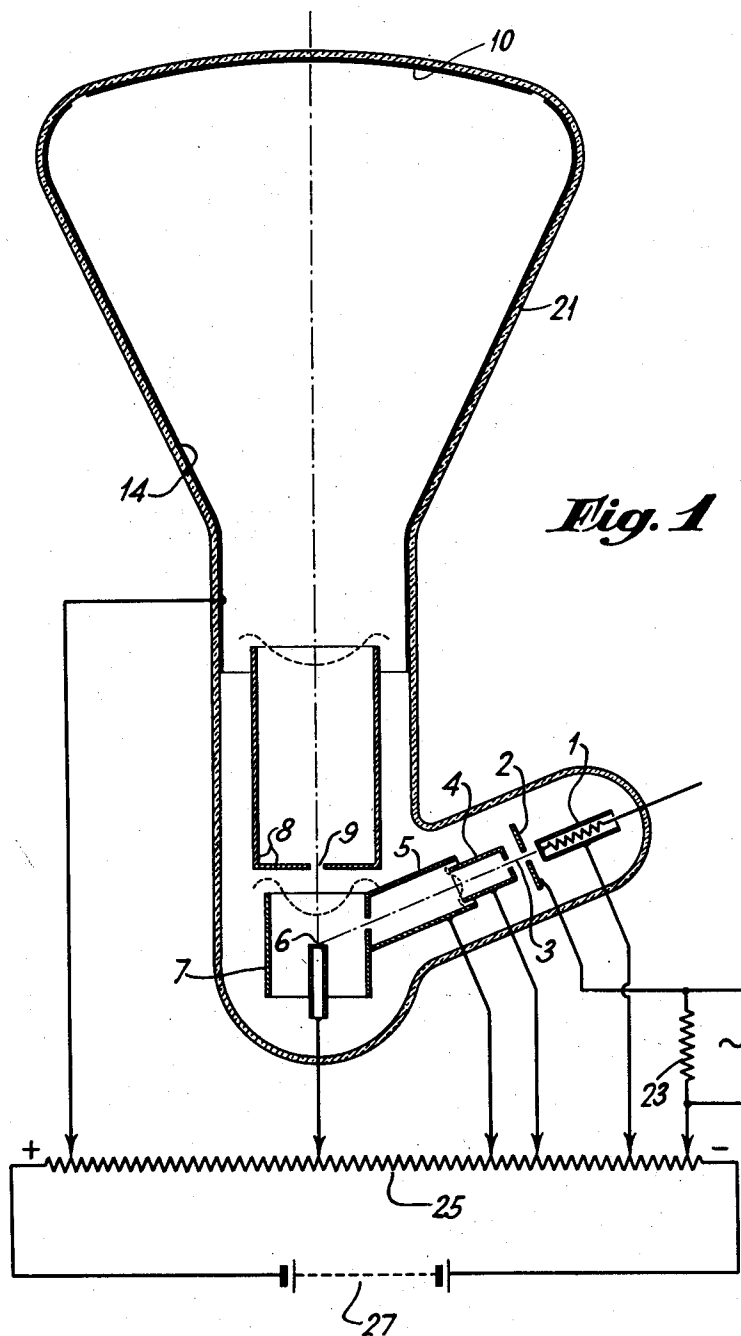
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2,197,033

ELECTRON DEVICE

Filed June 16, 1938

2 Sheets-Sheet 1



BY

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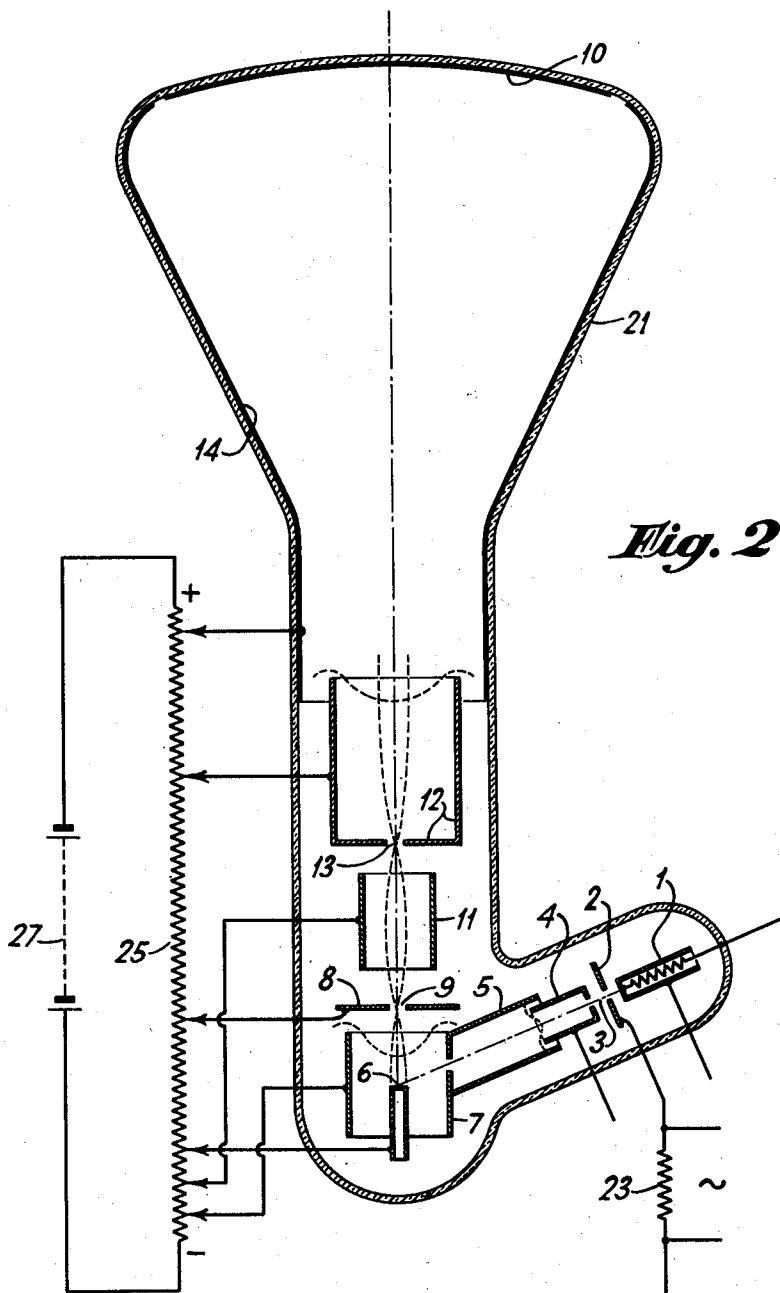
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ELECTRON DEVICE

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4 Claims. (Cl. 250—150)

This invention is concerned with a novel type of electron source for cathode ray tubes, especially those used for television work. The chief desideratum in the operation of such tube is to produce an intense and sharply focused spot upon the imaging surface, that is, a spot which will always preserve its focused and concentrated condition unaltered, even upon modulation of the intensity of the beam of electrons. The sharpness or the focus of the spot essentially is predicated upon three factors, to wit:

(1) Sharp geometric definition of the electronic source, this meaning both real and virtual sources of electrons;

(2) A constant field intensity of the fields presenting axial symmetry and employed for imaging the electron source; and

(3) Homogeneous ness of the cathode rays emerging from the real or the virtual electron source, and an unvaried angular distribution of the same even upon modulation of the number of electrons in the beam.

Attempts have been made in the prior art to meet the first named condition. However, the second and the third conditions where modulation of the cathode ray is used, has not been fulfilled because of the difficulties that modulation of, that is control of the intensity of the beam, is associated with alterations of the field intensity of the particular electron optical system to be imaged or focused, or an alteration of the velocity and/or the angular distribution of the electrons. Any suggestions that have heretofore been suggested with a view to obviating these drawbacks involve comparatively complicated technical means and expense and have not been satisfactory. The present invention discloses a simpler solution of the problem, and it indicates a way to create a so-called "punctiform" or highly concentrated source of electron supply which surpasses all similar sources of electrons disclosed in the earlier art as regards working life, yield, and homogeneity of emission, especially where the beam is modulated in intensity.

The basic idea of the invention shall be described more fully by reference to a cathode ray tube for television receiver purposes. The basic idea is that the pencil or jet of cathode rays issued from a powerful thermally emitting cathode is caused to bombard, after modulation, a secondary emission impactor surface of reduced dimensions having the shape of the object to be imaged. This impact or target surface, in contradistinction to the thermally emissive cathode,

acts and serves as the cathode properly so-called of the main path of the pencil of rays, and the same, directly or indirectly, is imaged upon the luminescent fluorescent screen or the like. The total emission of the heated cathode forming an element of the cathode arrangement may be far higher than the emission of a heated cathode of the sort heretofore used in cathode ray tubes since it is not material and essential whether the same is punctiform or not.

A further increase in the yield of electrons may be secured by secondary electron multiplication on the target surface struck by the primary electrons. Modulation is effected in the path of the rays of primary electrons, in such a way that the fields of the main beam having axial symmetry stay practically undisturbed. In this connection, care must be suitably taken so that the primary electrons will flow through only a tiny aperture into the field of an electrode pertaining to the main pencil path with the result that the field thereof remains practically undistorted. Modulation is insured either by virtue of velocity variation and/or by variation of the volume of primary electrons impinging upon the target surface. Variation of the volume or quantity could be accomplished by grid control or else by disposing the target surface as the base of a cone whose angle will vary in unison with the modulation. Moreover, the pencil or beam of electrons can be deflected unilaterally before impinging upon the target, or else upon a diaphragm or stop mounted at a point intermediate between the heated cathode and the target surface. No matter which of these different modes of modulation be used, the result is that the velocity and the angular distribution of the electrons issuing from the target surface stay substantially constant independently of the modulation. This fact is extremely important for a clean cut electron optical image of the target surface in the main ray pencil, under conditions independent of the modulation.

For further explanation of the disclosure, reference shall be made to the appended drawings where Fig. 1 shows diagrammatically one embodiment of the invention, while Fig. 2 shows a modification of the embodiment shown in Fig. 1.

The pencil of electrons issuing from the heated cathode 1 is subjected to the action of control modulation electrode 2, and it then enters into the opening 3 of the cylindrical electrode 4. In conjunction with the coaxially disposed electrode 5 maintained at a different potential, the said electrode 4 furnishes an electron lens field which

will collect or condense the electrons in such a way that they will essentially impinge upon the target 6. A small aperture of the electrode 5 terminates and issues into the cylindrical electrode 7 of the main ray path being kept at the same potential. The target surface 6 has the form of a planar circular disk, however, this disc may have an inwardly or outwardly directed curvature or it may be made annularly in shape.

10 In order to secure an emission which will present a geometrically sharp contour or line of demarcation, it is advantageous to de-activate the parts surrounding the target surface, insofar as primary electrons will bombard them, so as to preclude the chances of secondary electrons being given off thereby. That is to say, the said parts could, for instance, be roughened or granulated, or it may be convenient to coat the same with substances such as zirconium, zirconia, or carbonaceous material. The target itself it preferably kept at a definite potential, and the target material used may be nickel, which possesses a high degree of secondary electron emissivity or any substance of high secondary electron emissivity. The target has smaller dimensions preferably than the anterior face of the heated cathode placed opposite it, and it may be imaged upon the fluorescent or luminescent screen 10 or the like either directly or indirectly, for instance, by being focused first on a reduced scale upon the aperture of diaphragm 9 which is of lesser dimensions than the target surface, the said aperture thereupon being imaged and focused upon the fluorescent screen 10 by the aid of the lens field created between the electrodes 8 and 14.

If desired, as shown in Fig. 2, another reduction stage could be inserted, which would consist of the lens field set up between the electrodes 8, 11, and 12.

40 Having described my invention, what I claim is:

1. A cathode ray tube comprising an envelope having an electron receiving screen mounted within the envelope, a secondary emissive surface displaced from and parallel to the screen, an electron optical system positioned intermediate the screen and secondary emissive surface, means for projecting a beam of electrons from a thermionic cathode upon the secondary emissive surface to eject secondary electrons therefrom said secondary emissive surface having an

area smaller than that of the said cathode, and a unitary electrode common to both said electron optical system and said beam projecting means.

2. A cathode ray tube comprising an envelope 5 having a luminescent screen mounted within the envelope, a secondary emissive surface displaced from parallel to the luminescent screen, an electron optical system positioned intermediate the screen and secondary emissive surface, and means including a source of electrons to develop 10 a beam of electrons, said source of electrons having an area larger than the area of the secondary emissive surface, means to project the developed beam of electrons upon the secondary emissive surface, means to control the intensity of the developed beam of electrons in accordance with signalling potentials, and a unitary electrode common to both said electron optical system and said beam projecting means. 20

3. A cathode ray tube comprising an envelope having a luminescent screen mounted within the envelope, a secondary emissive surface displaced from and parallel to the luminescent screen, an electron optical system positioned intermediate 25 the screen and secondary emissive surface, means including a source of electrons to develop a beam of electrons, said source of electrons having an area larger than the area of the secondary emissive surface, means to project the developed beam of electrons upon the secondary emissive surface, means to modulate the developed beam of electrons in accordance with modulating potentials, and a unitary electrode common to both said electron optical system and said beam projecting means. 35

4. A cathode ray tube comprising an envelope having a luminescent screen mounted within the envelope, a secondary emissive surface displaced from and parallel to the luminescent screen, an electron optical system positioned intermediate 40 the screen and secondary emissive surface, an electron gun having an electron emitting surface for projecting a beam of electrons upon the secondary emissive surface, said electron emitting surface having an area larger than said secondary emissive surface, means to control the intensity of the beam of electrons in accordance with signal potentials, and a unitary electrode common to both said electron optical system and said beam projecting means. 45 50

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