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ELECTRON RAY TUBE

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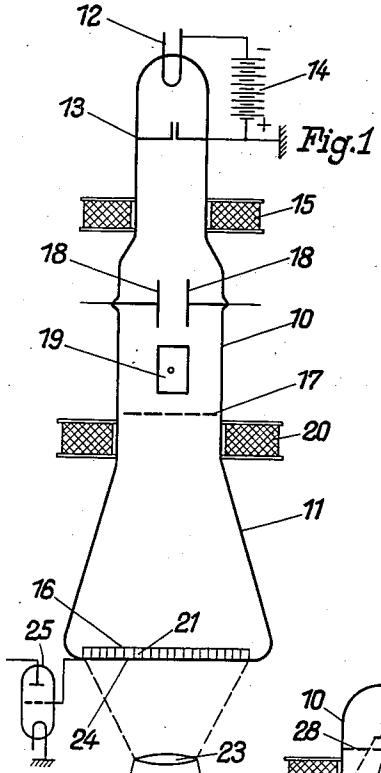

Fig.1

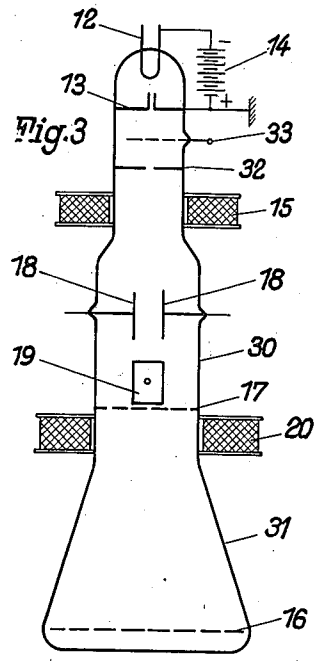

Fig.3

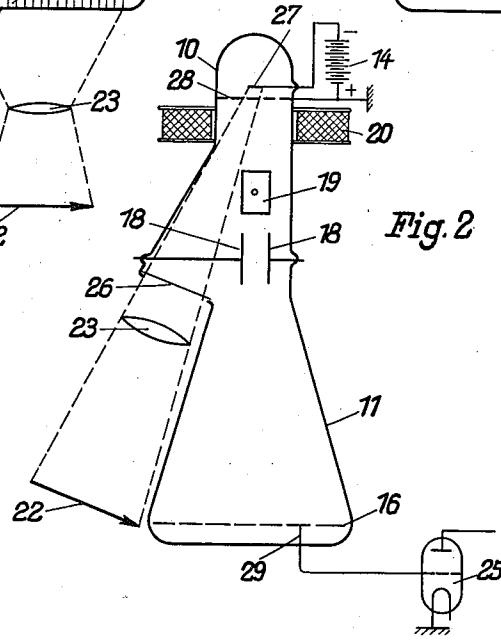

Fig.2

INVENTOR
LUDWIG SCHIFF
Stone, Boyden & Mack
ATTORNEYS

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ELECTRON RAY TUBE

Ludwig Schiff, Berlin-Lichterfelde, Germany, assignor to the firm Fernseh A.-G., Berlin-Zehlendorf, Germany

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9 Claims. (Cl. 178—7.2)

The invention relates to electron ray tubes for the purposes of television, of picture telegraphy and the like. The electron ray tubes can be employed both for transmission and also for reception. In the transmitter and in the receiver, the electron rays are so synchronously distributed that the pictures are scanned in a harmonious manner.

Both in the transmitter and in the receiver as great a picture surface as possible is now desired. In the transmitter it is desired in order that the picture to be transmitted may be scanned as accurately as possible.

Still more important is the size of the picture surface in the receiver. Television first attains its complete value when the picture produced can be simultaneously seen clearly by all the people present in a room or by everybody in a cinema-theatre.

With the present cathode ray tubes very serious difficulties arise, however, in the way of increasing the picture surface. Above all the cathode ray tube has to be given an exceptional length. By this the cost of the tubes would be not only increased to a very great extent, which, especially for reception apparatus that must remain attainable by the general public, would be practically impossible, but it would also be harmful to correct picture transmission. A size of picture of about e. g. 3 x 3 m. sufficing for a cinema-theatre would not indeed be practically attainable with the present cathode ray tubes, as the tubes would require a length of about 15 m. and over. It is also scarcely practically possible to enlarge by projection in the optical manner a small televised picture, as it is known that in this way about 98–99% of the intensity of light of the televised picture would be lost.

Furthermore indeed by a great length of tube the exactness of picture transmission is interfered with, as the individual electrons collide with each other on their long journey and, besides, there is correspondingly often the possibility of their hitting against gas molecules, whereby a scattering of the pencils of rays of electrons will be effected. In addition the influence of the earth's magnetic field and of other foreign deleterious fields is correspondingly great if the rays of electrons have a long journey.

According to the invention for the purposes of television, picture telegraphy and so forth it is possible to obtain a large picture surface with a proportionately short electron-tube, and to avoid the said disadvantages and thereby attain the novel technical advances hereinafter set forth, so that an electron image, that is not made visible, obtained in a plane, the first picture plane, in the interior of the electron-tube, is reproduced on a larger scale in a second picture plane. This enlarged electron-image can either itself be made visible or can likewise remain invisible, and be subjected to one or more further enlargements.

It is known that the rays of electrons can be assembled e. g. by electro-magnetic concentrating coils or by electro-static electrodes in an analogous manner to light rays by lenses, and that on this property of the electron rays so-called "Electron-optics" have been based, which have been employed for the attainment of one or more stages of enlargement of a real electron-image especially for the construction of electron microscopes. In this connection, however, it is always a question of the enlargement of still images, not for the purposes of television or of picture telegraphy, in which the object or the picture is transmitted by dots and scanned by dots.

A real still electron image, which is to be enlarged in one or more stages, is not generally present e. g. in reception apparatus for the purposes of television and picture telegraphy, but the bright or dark electron-image elements corresponding to the scanning are obtained consecutively only by dots in the plane of the real image.

For the exact purposes of television and picture telegraphy quite special technical advantages, which hitherto have not yet been known and realised, can be obtained now, by the enlargement of the electron-image arising in the scanning period.

The enlargement of the electron image within the electron-ray tube by projection from the first picture plane on to the second picture plane necessitates a much smaller length of construction of the tube than would be necessary in an ordinary tube for the direct attainment of a similarly large electron image. On the contrary by this enlargement the keeping of the first electron-image as small as desired is rendered possible, whereby the exact deflection is facilitated, the necessary deflecting tension diminished, the size and the capacity of the diffusion plates are reduced, the production costs of the tubes are diminished and the manipulation of the tube is facilitated and simplified.

In similar manner, as by the disposal of optical lenses in series the enlargement of a visible object can be increased within wide limits, so it is possible to enlarge within very wide limits the

electron-image, which is not directly visible, for example with the assistance of one or more similarly invisible intermediate images, and with a proportionately short length of construction of the electron tubes.

The invention is applicable to very different kinds of constructions of electron tube.

In Figs. 1 to 3 a few such tubes are diagrammatically illustrated.

Fig. 1 shows an electron ray tube which is applicable as a transmitter for televised pictures.

10 is the vacuum tube which is widened like a funnel at its lower end 11. The electrons are produced by the cathode filaments 12 and urged to the anode 13 by the tension of the battery 14 disposed between the anode and the cathode. The pencil of electron rays leaving the anode 13 is now according to the invention concentrated by the collecting coil 15 not in the plane 16 closing the tube but in a plane 17 lying in the inner tube, the "first picture plane." The pencil of rays is now so deflected by the pairs of electrodes 18, 19, in a manner known per se, that the focus describes a sinuous or zig-zag line in the first picture plane 17. The image of these lines is now reproduced on an enlarged scale in the plane 16 by means of the exactly adjustable collecting coil 20. In the plane 16 there is a system of photo cells 21 on which the picture 22 to be transmitted is reproduced by means of a glass lens 23 in known manner. The powerful current impulses corresponding to the different brightness of the individual image points are led through the common anode 24 in known manner to the grid of an amplifying tube 25 and applied, e. g., to the modulation of a high frequency transmitter. The advantage of the invention lies for an equal length of tube in a greater number of photo cells being able to be obtained and thus a finer screening of the picture to be transmitted.

Fig. 2 illustrates another construction of a transmission tube for television.

A proportionately small image of the subject 22 to be transmitted is projected onto the photo-electric layer (cathode) 27 through the window 26 of the tube by the lens 23. The electrons leaving, in greater or smaller number each according to their strength of illumination the individual points of the photo-electric layer 27—which represent an electron image corresponding to the optical image, are urged from the grid anode 28 by the tension of the battery 14. The photo-electric layer 27 here represents the first picture plane. The electron image of the first picture plane is—in contrast to the arrangement illustrated in Fig. 1—simultaneously reproduced in the second picture plane 16 as a whole by means of the collecting coil 20 and displaced in a zig-zag manner as a whole by deflection by means of the pair of deflecting plates 18, 19 and scanned by the peak (or end) of the fixed electrode 29. The current fluctuations are directed in known manner to the amplifying tube 25.

The intense enlargement by the collecting coil 20 advanced very near to the cathode 27 permits of keeping very small the image surface 27 and therefore the cross section of the pencil of rays leaving it which renders possible small proportions and small capacity of the deflecting plates. In spite of the great enlargement the transmission tube is only a proportionally short length of construction.

Fig. 3 illustrates a reception-tube 30 which is widened funnel-like at its lower part 31. The electrons are produced through the incandescent cathode 12 by means of the battery 14 and the anode 13. The intensity of the pencil of rays of electrons in the opening of the screen 32 is altered in the rhythm of the current fluctuation arriving from the transmitter by the control electrode 33. The orifice of the screen 32 is reproduced in the first picture plane 17 lying in the interior of the tube in accordance with the invention by the collecting coil 15. An electron picture is produced in the plane 17 by the lateral regulation of this image point by means of the deflecting plates 18, 19 and by the simultaneous regulation of intensity by means of the electrode 33. This picture is reproduced in the picture plane 16 on an intensely enlarged scale by collecting coil 20 advanced adjacent to the plane 17 and in known manner is made visible by a fluorescent layer disposed in this plane. Thus a very large image is produced in the plane 16 with a short length of construction of the tube. For the production of especially large pictures it is forthwith possible to employ, not only one intermediate image but a plurality of intermediate images.

In accordance with the invention also, instead of the magnetic collecting apparatus, electric collecting apparatus or a combination of both can be employed for the enlargement of electron images.

I claim:

1. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode filament, an anode, an electric current supply means connected between said cathode filament and said anode, a first collecting coil between said anode and the first image plane of the tube, pairs of deflecting electrodes between said coil and the first image plane of said tube, and an adjustable second collecting coil between said first image plane and the second image plane of the tube.

2. An electron ray tube for the purposes of television picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode filament, an anode, an electric current supply means electrically connected between said cathode and said anode, a first collecting coil between said anode and the first image plane of the tube, pairs of deflecting electrodes between said coil and said first image plane of the tube, a second adjustable collecting coil between said first image plane and a photo-electric device in the second image plane of the tube, an anode for said photo-electric device, an amplifier electrically connected to said photo-electric device, and an optical device for reproducing on said photo-electric device the picture to be transmitted.

3. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced picture planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode photo-electric device in the first picture plane of the tube, an

anode, an electric current supply means electrically connected between said cathode and said anode, pairs of deflecting electrodes between said anode and the second picture plane of the tube, a collecting coil between said anode and said deflecting electrodes, a fixed electrode in said second picture plane, an amplifier electrically connected to said fixed electrode, and an optical device for reproducing on said photo-electric device the picture to be transmitted.

4. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced picture planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode filament, an anode, an electric current supply means connected between said cathode and said anode, a first collecting coil between said anode and the first picture plane of the tube, means for adjusting the intensity of the electron rays in accordance with the rhythm of the current fluctuations arriving from the transmitter, pairs of deflecting electrodes between said coil and the first picture plane of the tube, and an adjustable second collecting coil between said first picture plane and the second picture plane of the tube.

5. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced picture planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode photo-electric device in the first picture plane of said tube, a grid anode, an electric current supply means electrically connected between said cathode device and said grid anode, pairs of deflecting electrodes between said anode and the second picture plane of the tube, a collecting coil between said anode and said deflecting electrodes, a fixed electrode in said second picture plane, an amplifier electrically connected to said fixed electrode, a lateral window in said container, and an optical device for reproducing through said window on said photo-electric device the picture to be transmitted.

6. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced picture planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode filament, an anode, an electric current supply means electrically connected between said cathode and said anode, a first collecting coil between said anode and the first picture plane of the tube, a screen between said anode and said first collecting coil, regulating means between said anode and said screen, pairs of deflecting electrodes between said coil and the first picture plane of the tube, and an adjustable second collecting coil between said first picture plane and the second picture plane of the tube.

7. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container having a widening like a funnel at one end, means for producing in said container in spaced planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode filament, an anode, an electric current supply means electrically connected between said cathode and said anode, a first collecting coil between said anode and the first image plane of the tube, pairs of deflecting electrodes between said coil and said first image plane, a second, adjustable collecting coil between said first image plane and a photocell device adjacent the outer end of the funnel part of the container in the second image plane of the tube, an anode for said photocell device, an amplifier electrically connected to said photocell device, and a glass lens device for reproducing on said photocell device the picture to be transmitted.

8. An electron ray tube for the purposes of television, picture telegraphy and the like comprising in combination an evacuated container, means for producing in said container in spaced picture planes a plurality of electron images one of which is an enlargement of another, said means comprising a cathode photo-electric device in the first picture plane of the tube, an anode, an electric current supply means electrically connected between said cathode and said anode, deflecting means located between said anode and the second picture plane of the tube, an electric lens between said anode and said deflecting means, a fixed electrode in said second picture plane, an amplifier electrically connected to said fixed electrode, and an optical device for reproducing on said photo-electric device the picture to be transmitted.

9. Apparatus for television, picture telegraphy and the like comprising in combination, an evacuated container, means for establishing an electron beam within said container, an electric lens for focusing said beam in a plane in said container, scanning means located between the source of said beam and said plane for sweeping said beam over an extended area in said plane, and a second electric lens arranged to act upon the beam proceeding from said plane to focus said scanned beam on an enlarged area in a second plane within said container.

LUDWIG SCHIFF.