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R. ORTHUBER ET AL

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BRAUN TUBE

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Fig. 1

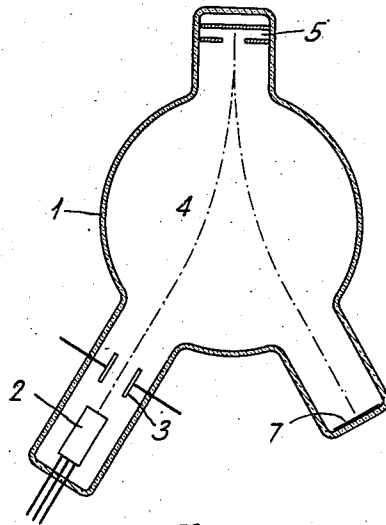


Fig. 2

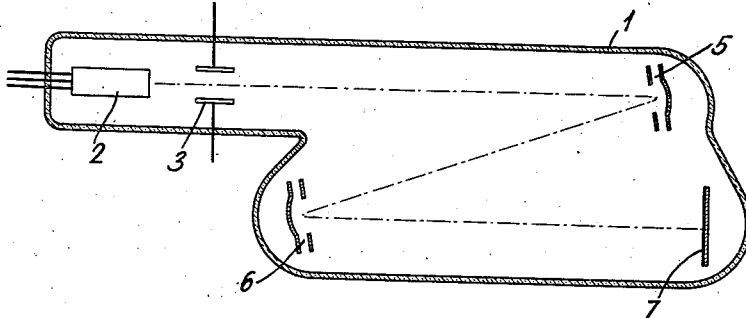
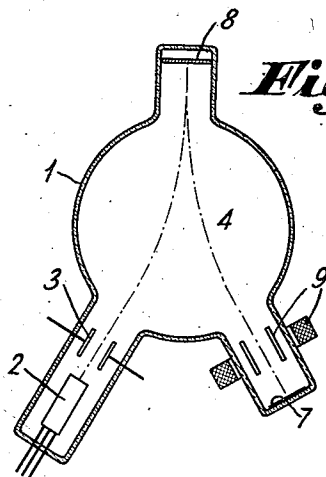


Fig. 3



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BRAUN TUBE

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1 Claim. (Cl. 250—162)

It is known that the sensitivity of a Braun tube is determined on the one hand, by the length of the path of the electron ray after completed deviation. However in Braun tubes of the usual type it is not practical to increase the sensitivity by extending the ray path, since in this case the tube would be of an undesirable length.

In order to obtain an electron beam having an extremely high sensitivity it has been proposed already to arrange several electron sources in a circle, and to concentrate through a reflection arrangement the various beams of rays into a single beam extending in the axis of the circle. In this way a long ray path is obtained, but the desired increase in sensitivity is hereby not achieved since the deviation can take place only after a single ray is produced.

According to the invention the ray following the passage through at least one deviation element is bent through the insertion of one or several electron mirrors or plates reflecting electrons. At each reflection the deviation angle is doubled so that at a small total length of the tube, large deviations can still be obtained with low deviation potentials or deviation currents.

As usual also in this case, an electron mirror is understood to be an arrangement in which the electrons reverse their course on the potential surface at which they no longer have a velocity at right angle to the surface. Hence it does not matter whether this surface is reproduced from metal or whether it is formed as a free surface in space having no substance. The term reflecting plate is to denote however, a metal plate likewise representing in general a potential surface, and on which the electrons impinge with finite velocity so that at this place only owing to the presence of the plate a reflection occurs which takes place in general under loss of velocity.

A mode of construction of the arrangement according to the invention in which an electron mirror is utilized is shown by way of example in the accompanying drawing in which Figs. 1, 2 and 3 show various forms of the invention in which electron mirrors are used.

Figure 1 shows a Braun tube 1 having an electron gun 2 in which the electron ray is produced in the known manner. After passing a deviation element 3 shown as a pair of deviation plates or which may also be replaced by a deviation coil pair, the electrons are deviated upon an electron mirror 5 by means of a magnetic field 4 whose lines of force extend at right angle

to the drawing plane. In place of the magnetic deviation field 4 also corresponding electrical fields may obviously be used, or a combination of such fields producing eventually a deviation without focusing.

Following the renewed passage through the field 4 in the opposite direction, the electron ray will again be curved and impinges on the fluorescent screen 7. The lens property of the electron mirror 5 can be utilized to recreate on the fluorescent screen the image in electrons of an object situated in front of the mirror, for instance the cathode, or a ray stop of the electron gun 2. A second deviation element, if necessary, may be arranged near the indicated element 3 in back of the mirror.

According to the invention it is not absolutely necessary to employ a single mirror. It may be of advantage to repeat the reflection of the electron ray by arranging additional electron mirrors at other places. This multiple reflection produces an increase in the sensitivity of the Braun tube without the necessity of a substantial lengthening of the arrangement.

Obviously it is also possible to employ elements for subsequent acceleration or additional reproduction-and-concentration arrangements. For instance, the entire tube 1 may be formed of metal, or it may have conducting material at least on the inside, and may for instance have plate potential applied thereto.

Another mode of construction of the arrangement according to the invention is shown in Figure 2. In this figure the course of the ray corresponds with that of a prism telescope, whereby the electron mirrors disposed parallel to each other take the place of the prisms. This arrangement of the electron mirrors has the effect that the ray leaving the second mirror is parallel to the ray which is going to impinge the first mirror.

If, in addition to the increase in sensitivity, an increase in the light intensity is to be achieved there may be suitably employed an arrangement utilizing reflecting plates, such as shown for instance in Figure 3. In this case, similar to Figure 1, the electron ray after passing through the deviation element 3 is bent by the magnetic field 4. The reflecting plate 8 is formed of metal having a high emission of secondary electrons. Since in a Braun tube, optically speaking, it is the question of obtaining a silhouette (on the fluorescent screen a small and sharply defined luminescent spot without substance must appear) no electron image needs appear on the

plate 8. The electron spot on the plate 8 amplified by secondary emission, is reproduced on the fluorescent screen 7 by the electrically, or electrically and magnetically operating acceleration lens 9. This reproduction is carried out preferably with a simultaneous increase of the electron spot. This increase on the one hand, causes an increase in the sensitivity, and on the other hand, also an enlargement of the image point. The enlargement of the image point which is as such undesirable, can be prevented however, through a decrease of the diameter of a ray stop inserted in the ray path whereby the spot on the plate 8 will be sufficiently decreased. The reduction in intensity thereby caused will be compensated for by the secondary emission on the plate 8, so that as a whole, a gain in intensity is obtained as compared with an arrangement without a reflecting plate or secondary electrons.

The electron mirror, in addition to being constructed as shown in the figures, may also be made by using a very fine mesh in place of the apertured first plate shown in the drawing. Behind the mesh would be positioned a plate, preferably of metal, and this plate would then be connected to a source of potential which is negative with respect to the ray. By such construction the points of equi-potential between the mesh and the back plate would lie in planes parallel to the plate and mesh and a plane electron mirror of greater area would be produced. The operation would be similar to the mirrors

shown in the drawing, i. e., the electron stream would penetrate the mesh and would be reversed in direction in the region between the mesh and the magnetic back plate by the field existing in this region.

Also in the present case a further increase in sensitivity and intensity can be achieved by providing several reflecting and amplifying plates, whereby it may eventually be suitable to bend the same ray path at various places by means of mirrors or reflecting plates.

It is to be understood that various modifications may be made in the device and that such modifications shall fall within the spirit and scope of the invention as defined in the following claim.

We claim as our invention:

A discharge tube comprising means at one end of the tube for producing a narrow focused beam of electrons, electrostatic decelerating means at the other end of the tube for reducing the velocity of the electrons to substantially zero and for reversing the direction of travel of the beam of electrons comprising an electrostatic electron mirror, and electron responsive means positioned in the path of the reflected beam of electrons whereby the length of the path traversed by the beam of electrons may exceed the length of the discharge tube.

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