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E. RUSKA

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COMBINED DEFLECTING DEVICE FOR CATHODE RAY TUBES

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Fig. 1

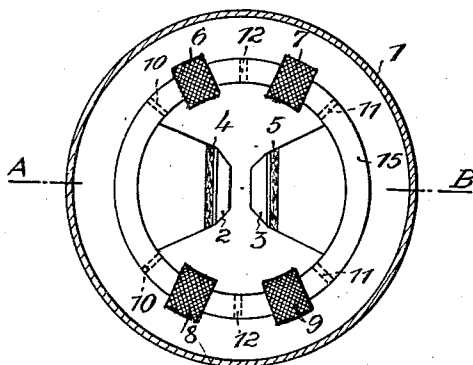


Fig. 2

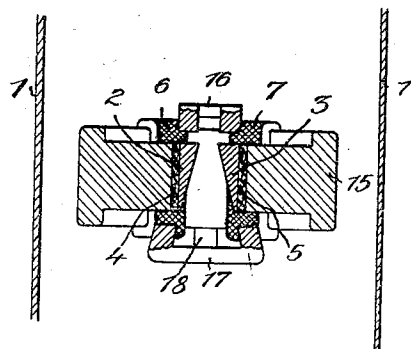
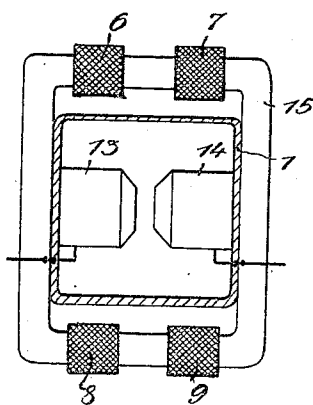


Fig. 3



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COMBINED DEFLECTING DEVICE FOR
CATHODE RAY TUBES

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2 Claims. (Cl. 250—27)

This invention relates to combination magnetic and electric beam deflecting systems for Braun tubes.

The object of the invention is to provide a system for deflection in two coordinates vertical to one another, and to combine maximum sensitivity with shortest length. Owing to the slight expenditure for sweep circuits resulting therefrom and the small length of the electron tube attainable thereby, considerable technical and economic advantages can be obtained, for instance when the tube serves as scanning or reproducing member in television.

To attain its end the invention provides for electric deflection of the cathode ray in one coordinate, preferably in the one having the higher frequency, and for magnetic deflection thereof in the other coordinate disposed vertically to the first. The main feature of the invention consists in employing a magnetic and an electric deflecting field coinciding in space. The extent of these fields is limited to the space required for beam motion in deflection. For this purpose, ferromagnetic pole pieces having the same face as the deflecting plates are arranged directly behind the plates of an electric deflecting system adapted to the beam deflection, or the plates themselves are constructed as magnetic pole pieces. The plates can either be insulated and secured to the front of the pole pieces, or the electric deflecting potentials are put on the pole pieces themselves, if the connecting magnet yoke or yokes are metallically interrupted at one point and the parts are electrically insulated relative to one another. To keep down the magnetic resistance of the yoke, these interruptions must be as short as possible.

Furthermore, the sum of the insulation gaps should be as small as possible with respect to the distance between the pole pieces, though, on the other hand, the capacity of the parts on the electric control potential relative to their environment must not be too great.

These considerations determine the extent of insulation. If the exciting coil is not to be brought into the vacuum, the pole piece deflecting plates are preferably continued almost up to the wall of the Braun tube, whereas the ferromagnetic yoke provided with the exciting windings extends with both ends from outside closely up to the point of the inner pole pieces. In this construction, the wall of the tube serves therefore as yoke insulation, and the coil need not be put in the vacuum. The tube wall may have a special form for this purpose.

If the coil is disposed in the vacuum, the windings thereof must be separated from one another and from the yoke by an insulation capable of withstanding the temperature developed during baking of the tube. Oxidation, e. g. copper oxide, is suggested, it being possible for instance to wind the coil of bare wire and, following degasification, to oxidize it by a controlled air supply.

For extreme limitation of the space filled with the deflecting fields with respect to low inductance the face of the pole piece electrodes can be curved along the direction of the ray in such a way that a marginal electron of the pencil of rays falling into the system flows at the maximum deflecting voltage between and along the two pole pieces.

By way of example, two embodiments of the invention are illustrated in the accompanying drawing, in which Figure 1 is a view of a deflecting system seen in the direction of the cathode; Fig. 2, a section on the line A—B, of Fig. 1; and Fig. 3, a view of another arrangement.

Referring to the drawing, in the embodiment according to Figs. 1 and 2 the deflecting system is located entirely inside the tube 1. The ends of the pole pieces, designated 2 and 3, are constructed as deflecting plates and, with the interposition of the insulations 4 and 5, joined to the iron yoke 15 of the magnetic deflecting system. The inwardly disposed surfaces of the pole pieces serve also for the development of the electric field. The yoke is annular to fit the round neck of the tube and carries the exciting coils 6, 7, 8, 9. Instead of the insulations 4 and 5, insulations may be provided at 10 and 11 or only at 12, and the coils 6, 7 and 8, 9 may each be replaced by a continuous coil.

A construction of a system with the coils arranged outside the vacuum is shown in Fig. 3. The pole pieces 13 and 14 are extended up to the glass wall, and the yoke closely passes on the outside of the tube 1 of square cross section the end faces of the pole pieces, so that only a small air gap is formed by the glass wall.

Since it is one of the objects of the invention to build a Braun tube of smallest possible length, the combination deflecting field is made as wide-angled as possible. Special attention is therefore paid to the marginal fields which, to avoid spot distortion, must outwardly approach zero as quickly as possible. The magnetic figure of the marginal fields must, furthermore, be the same in all planes that are vertical to the faces of the deflecting system. For this purpose, ferromag-

netic counter-electrodes are fixed oppositely, and closely to, the pole piece electrodes, on which both the electric and the magnetic marginal field can terminate. Such counter-electrodes are indicated at 16 and 17 in Fig. 2.

To attain complete field symmetry these counter-poles are preferably located on the middle magnetic and electric potentials. These middle potentials are constant in time, whereas the electric and magnetic pole piece potentials fluctuate about these values. To fix the magnetic middle potential the counter-poles may be connected at 18, in the center of the yoke winding, to the yoke by iron circuit. The yoke may also get the electric middle potential. If, however, for any reason, the iron yoke is to receive another electric potential, the ferromagnetic circuit between the middle of the iron yoke and the counter-pole can be interrupted again by the interposition of an electric insulation 19 and 21.

The outline limitation of the counter-electrodes facing the ray is preferably parallel to the ray on the entering side of the deflecting system and discloses about the same relative distance as the pole piece electrodes. On the leaving side, the

counter-poles continue approximately the vanishing line of the pole pieces.

I claim:

1. A cathode ray deflecting device in combination with a cathode ray tube having an envelope, comprising an annular electromagnetic yoke, opposed poleshoes inwardly projecting from said yoke, pole faces disposed upon and insulated from said poleshoes, and connecting means for supplying a varying potential to said pole faces.

2. A cathode ray deflecting device in combination with a cathode ray tube having an envelope, comprising electromagnetic means including an annular yoke having poleshoes for deflecting the electron ray by a magnetic field in one direction, means for producing an electrostatic field having the same extent and distribution as the electromagnetic field, said means including faces disposed upon but insulated from said poleshoes and connecting means for supplying a varying potential to said faces, and means for controlling the edge-fields of said faces, comprising electrodes connected to said yoke midway between said poleshoes.

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