May 26, 1942. H. W. PAEHR 2,284,227

MAGNETIC ELECTRON LENS

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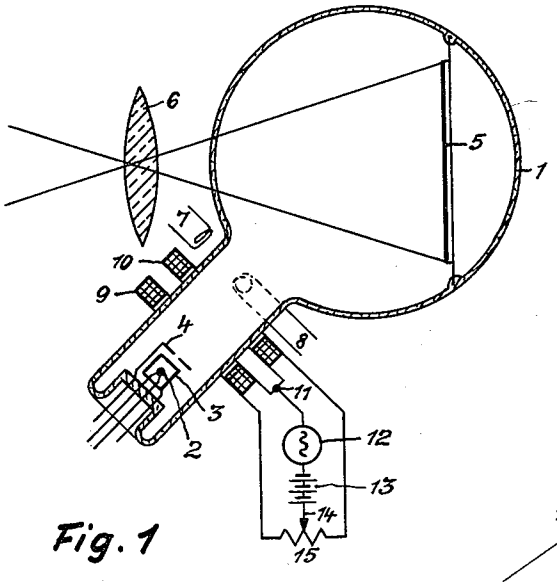


Fig. 1

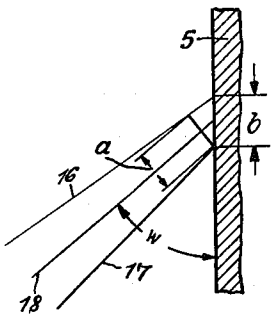


Fig. 2

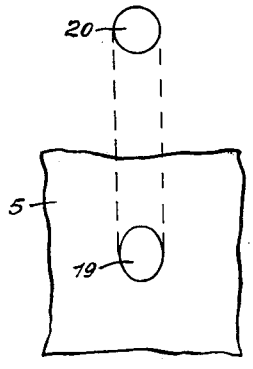


Fig. 3

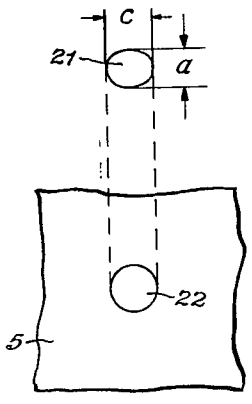


Fig. 4

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MAGNETIC ELECTRON LENS

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6 Claims. (Cl. 25—27)

This invention relates to magnetostatic electron lenses used in connection with cathode ray tubes, particularly of the type in which the ray impinges upon the screen of the tube under an oblique angle. The invention is particularly concerned with cathode ray tubes for television purposes for instance of the projection type having a screen situated obliquely to the electron optical axis of the tube. The invention can also be used in connection with storage tubes for television transmissions including a mosaic screen which is also arranged obliquely to the direction of the undeflected ray.

It is an object of the invention to provide a cathode ray tube in which the spot produced on the screen of the tube by the cathode ray has non-elongated shape and in particular a circular or square form in spite of the fact that the cathode ray incides under an angle on the screen. It is a further object to use a cathode ray of non-circular, elongated, for instance elliptical, cross section in order to compensate the distortion of the spot, to focus the cathode ray by a magnetic field, and to provide adjusting means by which the elongated cross section of the cathode ray can be rotated at will through a definite angle without at the same time altering the focal length of the magnetic lens and without thereby influencing the sharpness of the spot.

According to the invention the magnetic lens is connected with means for keeping the total current flowing through the windings of the coil at a constant value. The coil includes two groups of windings connected in such a manner to a source of potential that the current flows through the windings of one group in a direction opposite to that through the windings of the other group. Adjusting means are provided to regulate the amount of current flowing through the windings of the two groups.

The nature of the invention and the operation thereof will be best understood from the following detailed description when read in connection with the drawing in which

Fig. 1 illustrates a specific embodiment of the invention while

Fig. 2 shows a cross section through a part of the screen of a cathode ray tube and

Fig. 3 and Fig. 4 each show a plan view of a portion of the screen.

The arrangement of Fig. 1 includes a cathode ray tube 1 having an electron gun for producing a cathode ray. The gun comprises a cathode 2 of the hair pin type, a Wehnelt cylinder 3 and an anode 4. The cathode ray tube contains a screen 5 covered with fluorescent material. The light produced by the impingement of the cathode ray is projected by means of a lens 6 unto a projection surface which is not shown in the drawing. The cathode ray tube is provided with deflecting systems 7 and 8 of conventional design. The neck of the tube is surrounded by focusing coils 9 and 10. The two windings are connected to one another and the common point 11 is connected by way of an iron-hydrogen resistance element 12 to one pole of a source of potential 13. The other pole of the source of potential 13 is connected to the sliding point 14 of a potentiometer 15, the two ends of which are connected to the ends of the two windings 9 and 10.

Fig. 2 shows in detail on an enlarged scale a part of the screen in cross section at a point where the cathode ray impinges upon the screen. The cathode ray indicated by lines 16 and 17 includes an angle w with the surface of the screen 5. If the cathode ray has circular cross section in a plane perpendicular to the axis 18 of the ray with a diameter a the spot on the screen will be elliptical, the long axis of the spot having the dimension b. This case is shown in Fig. 3 in a plan view. The circle 20 represents the cross section of the ray and 19 the form of the spot on the screen. In order to compensate this distortion of the spot, a cathode ray of elliptical cross section is used. Fig. 4 shows the cross section 21 of such a cathode ray which produces upon the screen a circular spot 22 with the diameter c. In order to obtain a compensation and not a magnification of the distortion it is necessary that the long axis c of the cross section of the cathode ray lie in the direction perpendicular to the line on the screen including the smallest angle w with the cathode ray. The ratio of the dimensions a and c is so chosen that the value c/a is equal to $1/\sin w$ in order to produce a circular spot.

A cathode ray of the desired cross section may be produced by an electron gun having a cathode with an elongated emitting surface. It is for instance possible to use a hair pin type cathode consisting entirely of tungsten or coated at the top of the bend with a substance of high emitting properties. It has been found very difficult to insert a cathode of this type in such a manner into the tube that the direction of the long axis of the emitting surface has exactly the required position with regard to the screen. In order to adjust the direction of the axis with

regard to the screen surface a magnetic lens is used consisting of two coils 9 and 10. An ordinary magnetic lens would produce a certain rotation of the image of the emitting surface. This rotation depends upon the current flowing through the coil. The amount of current is however determined by the focal length of the lens and cannot be changed without at the same time altering the focal length and thereby decreasing the sharpness of the spot. According to the invention the angle of the rotation is adjusted by using a lens of particular form, having two groups of windings 9 and 10.

The coils 9 and 10 shown in Fig. 1 are preferably of the same dimensions. The iron-hydrogen resistance element 12 is a constant current device keeping the total current flowing through both coils at a constant value while the relative amounts of current through the single coils can be adjusted by moving the contact 14 of potentiometer 15. The resistance element 12 can be replaced by any other form of current limiting device, as, for example, a saturated valve. While an arrangement of this kind allows in most cases a sufficient adjustment of the angle without practically influencing the sharpness of the spot, a more exact compensation can be obtained if the sum of the squares of the current flowing through the individual coils is kept at a constant value. In this case the iron-hydrogen resistance element 12 is replaced by a device having a resistance which is a function of the load and which decreases with increasing load, for instance an uran-dioxyde resistance element.

With the above described arrangements the image of the cathode can be rotated simply by moving the contact point 14 of potentiometer 15, the sharpness of the image remaining unchanged. Instead of the emitting surface of elongated form an aperture of desired shape can be used. In this case an image of the aperture is produced on the screen. The method of the invention has the advantage that the electron gun can be inserted into the cathode ray tube without controlling the exact position of the emitting surface. The desired situation of the spot relatively to the screen is obtained by corresponding adjustment of the currents flowing through the focusing coils.

The invention is not limited to the embodiment described in connection with the drawing. It can be used in connection with cathode ray tubes for all purposes in which it is required to rotate the electron image through a certain angle without at the same time altering the focal length of the lens system.

What I claim is:

1. An arrangement with a cathode ray tube having a screen situated obliquely to the direction of the undeflected ray and an electron gun adapted to produce a cathode ray of elliptical cross section, including a magnetic electron lens for focusing the cathode ray and circuit connections for said lens including a single control means for adjusting the angle of rotation produced by said lens while the focal length of said lens remains practically constant.

2. A magnetic electron lens for a cathode ray tube including a screen arranged obliquely to the electron optical axis of the tube, said cathode ray tube having an electron gun adapted to produce a cathode ray of elongated cross section, said lens consisting of a coil having two groups of windings, said groups of windings being connected to a source of potential in such a manner that the current flows through the windings of one group in a direction opposite to that through the windings of the other group, means including a single control device being provided between the source of potential and the windings adapted to adjust the individual winding currents while maintaining the total current at a constant value.

3. A circuit arrangement for a magnetic lens having two groups of windings including a source of potential, a constant current device and a single potentiometer, said groups of windings being connected at one side with one another and by way of a constant current device to a pole of the source of potential, while the other terminals of the groups of windings are connected to both ends of said potentiometer and the movable contact of said potentiometer is connected to the remaining pole of the source of potential.

4. The combination with a cathode ray tube having a screen lying obliquely to the electron optical axis of the tube and an electron gun producing a cathode ray of elongated cross section, of two focusing coils surrounding the path of the cathode ray, of a source of potential feeding the coils with current of opposite direction, of a current limiting device in the path of the total current and of a single potentiometer for varying the amount of current flowing through each coil without altering the total current.

5. The combination with a cathode ray tube having a screen lying obliquely to the electron optical axis of the tube and an electron gun producing a cathode ray of elongated cross section, of two focusing coils surrounding a part of the tube, of a source of potential feeding the coils with current of opposite direction, of an iron-hydrogen resistance element in the path of the total current and of a single potentiometer for varying the amount of current flowing through each coil without altering the total current.

6. The combination with a cathode ray tube having a screen lying obliquely to the electron optical axis of the tube and an electron gun producing a cathode ray of elongated cross section, of two focusing coils surrounding a part of the tube, of a source of potential feeding the coils with current of opposite direction, of a current limiting device in the path of the total current and of a single potentiometer for varying the amount of current flowing through each coil without altering the sum of the squares of the currents flowing through said two coils.

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