July 11, 1939. I. G. MALOFF 2,165,803

CATHODE RAY DEFLECTING DEVICE

Filed April 25, 1936

Fig. 1

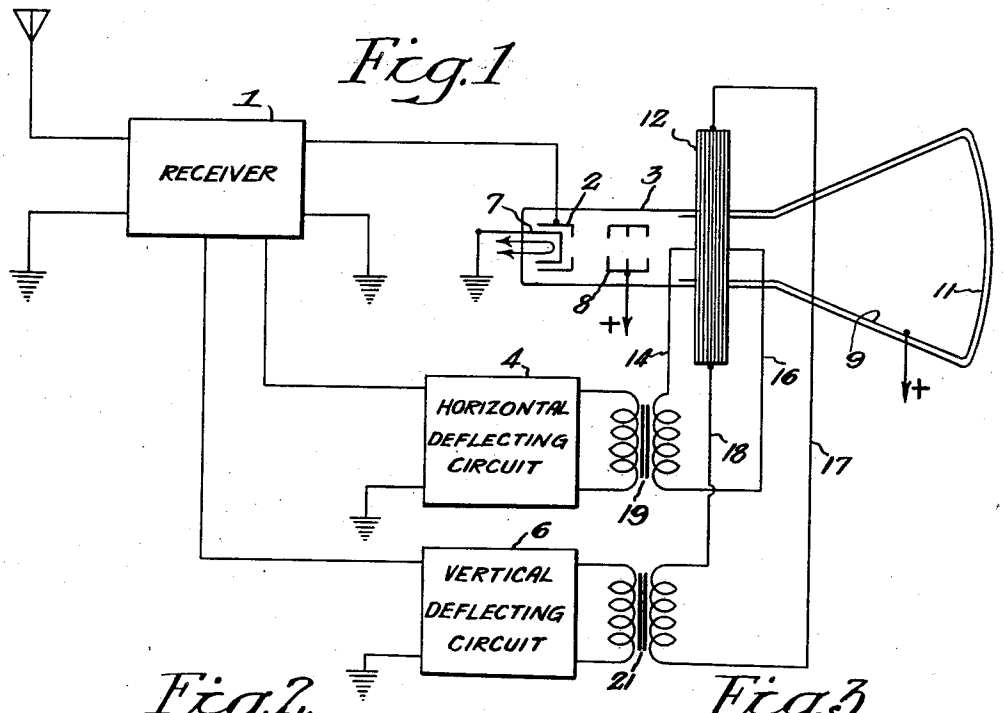


Fig. 2.

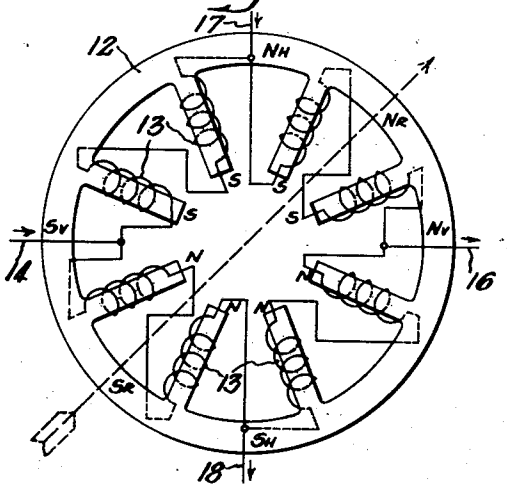


Fig. 3.

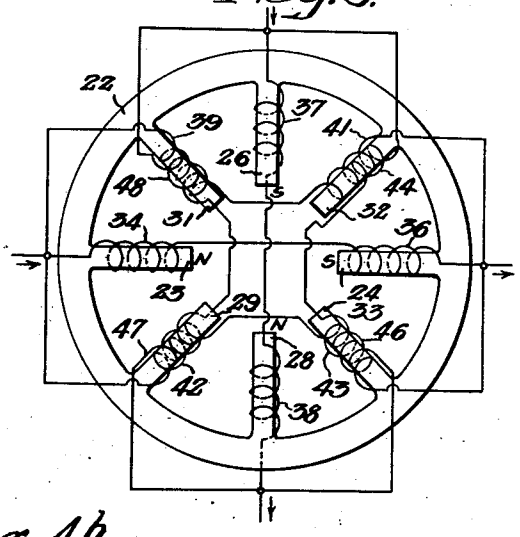


Fig. 4a

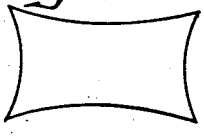
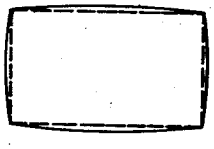


Fig. 4b



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CATHODE RAY DEFLECTING DEVICE

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5 Claims. (Cl. 250—157)

My invention relates to cathode ray deflecting devices and particularly to deflecting devices of the electro-magnetic type.

In television receivers employing cathode ray tubes and in cathode ray oscillographs it is necessary to provide means for deflecting a cathode ray simultaneously in two directions which are substantially at right angles to each other. In the past, when electro-magnetic deflection was employed, two pairs of deflecting coils were employed, one pair for horizontal deflection and one pair for vertical deflection. It was found that, in television receivers, especially, this was not altogether satisfactory for two reasons. In the first place, the cathode ray did not scan a truly rectangular pattern even though deflected by perfect saw-tooth waves, and, in the second place, the deflecting field tended to defocus the cathode ray.

Accordingly, it is an object of my invention to provide an improved deflecting device of the above-mentioned type.

It is a further object of my invention to provide an improved deflecting device which causes a cathode ray to scan a substantially rectangular pattern when supplied with saw-tooth deflecting current.

It is a still further object of my invention to provide an electro-magnetic deflecting device which deflects a cathode ray with a minimum of defocusing.

In a preferred embodiment of my invention the deflecting yoke includes a magnetic core having eight pole pieces instead of the usual four pole pieces. The horizontal and vertical deflecting windings may be wound on these pole pieces in several different ways. One way is to wind the deflecting coils on the eight pole pieces as a continuous winding, the vertical deflecting current being supplied to the continuous winding at diametrically opposite points and the horizontal deflecting current being supplied to the winding at diametrically opposite points located 90° away from the first mentioned points. With this arrangement, the vertical deflecting current and the horizontal deflecting current flow through the same deflecting windings to provide the desired resultant deflecting fields.

Another way of applying the deflecting windings to the pole pieces is to provide six windings (three pairs of coils) for the vertical deflection, these windings being placed on diametrically opposite pole pieces and being connected with the three pairs of coils in parallel. Similarly six deflecting coils are provided for horizontal deflection, these coils being placed on six diametrically opposed pole pieces and being connected the same as the vertical deflecting coils.

With this arrangement, there is a single deflecting coil on each of two diametrically opposed pole pieces which may be referred to as the main vertical deflecting pole pieces and likewise there is a single horizontal deflecting winding on each of two diametrically opposed pole pieces which may be referred to as the main horizontal deflecting pole pieces. The remaining four pole pieces, which may be referred to as the shading or correcting pole pieces each have two windings thereon, one winding being a vertical deflecting winding, the other winding being a horizontal deflecting winding.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawing of which Figure 1 is a schematic diagram of a television receiver embodying my invention;

Figs. 2 and 3 are views showing two different embodiments of my invention and

Figs. 4*a* and 4*b* indicate the shapes of two scanning patterns which are referred to in explaining the invention.

Referring to Fig. 1, one embodiment of my invention is shown applied to a television receiver of the type comprising a radio receiver **1** for the reception of a carrier wave modulated by picture and synchronizing signals. The carrier wave is demodulated in the receiver **1** and the picture signals are supplied to the control grid **2** of a cathode ray tube **3**. The horizontal synchronizing impulses are supplied to a horizontal deflecting circuit **4** while the vertical synchronizing impulses are supplied to a vertical deflecting circuit **6**.

The cathode ray tube **3** preferably is of a well known type comprising an evacuated envelope having therein an indirectly heated cathode **7**, the control grid **2**, a first anode **8**, a second anode **9** and a fluorescent screen **11**. In this type of cathode ray tube the cathode ray is electrostatically focused by means of the electrostatic field between the first anode **3** and the second anode **9**.

Referring to Figs. 1 and 2 the deflecting yoke for the tube **3** comprises a laminated iron core **12** having eight pole pieces spaced 45 degrees apart. As shown in Fig. 2 these pole pieces are provided with a continuous winding, i. e., there is a winding on each pole piece and all the windings are connected in series to form a closed circuit. The horizontal deflecting current is supplied to

the continuous winding 13 at diametrically opposite points through the leads 14 and 16. The vertical deflecting current is supplied to the continuous winding 13 at diametrically opposite points through the leads 17 and 18.

As indicated by the letters N and S at the inner ends of the pole pieces, the windings are wound in such direction that current flowing from the lead 14 through the winding to the lead 16 will make the inner ends of the four lower pole pieces north and the inner ends of the four opposing pole pieces south, assuming there is no flow of vertical deflecting current. The corresponding polarities at the outer ends of the pole pieces, i. e., at the ring of the core 12, are south and north as indicated by the letters S_H and N_H.

Vertical deflecting current flowing from the lead 17 through the deflecting coils and out the lead 18 will cause the inner ends of the four right hand pole pieces to be of south polarity and the inner ends of the four left hand pole pieces to be of north polarity, assuming there is no flow of horizontal deflecting current. The corresponding north and south polarities of the pole pieces at their outer ends are indicated by the letters N_V and S_V. If the vertical and horizontal deflecting currents are flowing simultaneously and if the magnetic fluxes produced by these currents are equal, the resultant deflecting flux will be in the plane indicated by the dotted arrow, and the polarity at the ring of the core will be that indicated by the letters N_R and S_R.

The vertical and horizontal deflecting circuits preferably are of such design that they will produce a flow of saw-tooth current through the deflecting coils.

As shown in Fig. 1, the deflecting coils preferably are coupled to the deflecting circuits 4 and 6 through transformers 19 and 21, respectively. This is almost a necessity when a winding of the character shown in Fig. 2 is employed, since the comparatively low frequency vertical deflecting current flows through the same coils as the comparatively high frequency horizontal deflecting current. It follows that if the impedance of the deflecting winding is correct for the horizontal deflecting circuit it will be much too low for the vertical deflecting circuit. The impedance of the coils, therefore is effectively increased by means of the transformer 21. The transformer 19 for the horizontal deflecting circuit may be omitted, if desired, or the deflecting coils may be given the proper impedance for the vertical deflecting circuit and a transformer employed only for coupling the horizontal deflecting circuit to the deflecting coils.

In the particular embodiment of my invention being described, all of the deflecting coils have the same number of turns. As will be explained later, however, it may be desirable to have fewer turns on certain coils than on others.

It may be noted that as a modification of the deflecting yoke shown in Fig. 2, the direction of winding of the coils in two opposing quadrants of the yoke may be reversed. For example, the coils on the two poles adjacent to the character S_R and the coils on the two poles adjacent to the character N_R may have their direction of winding reversed. In that case the deflecting fields (horizontal and vertical) will be rotated 90 degrees from their position illustrated in Fig. 2.

The eight-pole deflecting yoke illustrated in Fig. 2 will give a much more uniform deflecting field in the plane of the yoke than will the conventional four-pole deflecting yoke. This is apparent from an inspection of the polarity marking of the pole pieces at their inner ends, this marking being for the condition of horizontal deflecting current flowing in the direction indicated by the arrows when there is no flow of vertical deflecting current.

The effect of this increase in uniformity of the deflecting field will be seen by a comparison of the deflecting patterns shown in Figs. 4*a* and 4*b*. These patterns are those produced on the fluorescent screen 11 of the cathode ray tube as the screen is scanned by the cathode ray. The pattern indicated in Fig. 4*a* is a type of pattern which is obtained by deflecting the cathode ray with the conventional four-pole deflecting yoke. The deflecting pattern indicated in Fig. 4*b* in solid lines is the pattern which is obtained when deflecting the cathode ray with the deflecting yoke shown in Fig. 2. It will be noted that this pattern, which is one that was actually obtained in practice, corresponds very closely to the perfect rectangle indicated by the dotted lines. While there was a certain amount of "over-correction" which reversed the curvature of the sides of the pattern, it was not great enough to be very objectionable.

What is perhaps an even more important benefit derived from my multi-pole deflecting yoke is that there is less defocusing of the cathode ray at the fluorescent screen during deflection.

If desired, my ring or closed type of winding illustrated in Fig. 2 may be applied to a deflecting yoke having only four pole pieces. Obviously, however, the yoke structure illustrated is preferable because of the great increase in the uniformity of the deflecting field.

Referring to Fig. 3, this embodiment of the invention includes a magnetic core 22 which may be identical with the core employed in the modification shown in Fig. 2. In this embodiment of the invention the pole pieces 23 and 24 will be referred to as the main vertical deflecting pole pieces, the pole pieces 26 and 28 will be referred to as the main horizontal deflecting pole pieces and the pole pieces 29, 31, 32 and 33 will be referred to as the correcting or shading pole pieces.

The main vertical deflecting coils 34 and 36 may be wound on the pole pieces 23 and 24 and connected in series in the usual manner. Likewise, the main horizontal deflecting coils 37 and 38 may be wound on the horizontal deflecting pole pieces 26 and 28 and connected in series in the usual manner. The letters N and S at the inner ends of the pole pieces indicate their polarity as the time deflecting current is flowing in the direction indicated by the arrows.

Each shading pole has two windings thereon, one winding being connected in the vertical deflecting circuit and the other winding being connected in the horizontal deflecting circuit. Thus it will be seen that the windings 39 and 41 on the two upper shading poles 31 and 32 are connected in series with each other and in parallel with the main vertical deflecting windings 34 and 36. Likewise, the windings 42 and 43 on the two lower shading poles 29 and 33 are connected in series with each other and in parallel with the main vertical deflecting coils 34 and 36. The direction of winding of the coils 39 and 41 is the same as that of the main deflecting coils 34 and 36, respectively. Likewise, the direction of winding of the coils 42 and 43 on the lower shading poles is the same as that of the main deflecting coils 34 and 36, respectively.

Referring now to the auxiliary windings in the horizontal deflecting circuit, the coils **44** and **46** on the right hand shading poles **32** and **33** are connected in series with each other and in parallel with the main horizontal deflecting windings **37** and **38**. Likewise, the coils **47** and **48** on the left hand shading poles **29** and **31** are connected in series with each other and in parallel with the main horizontal deflecting windings **37** and **38**. As in the case of the windings in the vertical deflecting circuit, the windings **44** and **48** on the two upper shading poles **31** and **32** are wound in the same direction as the horizontal deflecting winding **37** and the windings **46** and **47** on the other shading poles are wound in the same direction as the horizontal deflecting coils **38**.

In one preferred embodiment of the invention, each coil contains the same number of turns. Therefore, each shading pole has thereon twice as many turns as the main deflecting poles. It has been found that this embodiment of my multi-pole deflecting yoke gives the same improved results as to the shape of the deflecting pattern and as to reduction in defocusing of the cathode beam as does the deflecting yoke previously described.

It will be understood that although I have described two embodiments of my invention in which each winding contains the same number of turns, it may be preferred to employ a different number of turns on certain pole pieces in order to obtain a deflecting pattern which approaches a rectangle still more closely and which still further reduces defocusing of the cathode ray. Furthermore, it will be apparent that still more satisfactory results may be obtained by utilizing a deflecting yoke with more than eight pole pieces.

From the foregoing description it will be apparent that various modifications may be made in my invention without departing from the spirit and scope thereof and I desire therefore that only such limitations shall be imposed thereon as are necessitated by the prior art and set forth in the appended claims.

I claim as my invention:

1. A deflecting device for a cathode ray tube, said device comprising a pair of diametrically opposed deflecting coils so connected that their opposing poles are of unlike polarity, and a second pair of diametrically opposed deflecting coils so connected that their opposing poles are of unlike polarity, adjacent poles of said pairs being of like polarity, said coils being so located that the axis of one pair of coils and the axis of the other pair of coils intersect at an angle which is substantially greater than zero degrees and less than 90 degrees.

2. A deflecting device for a cathode ray tube, said device comprising a pair of diametrically opposed deflecting coils so connected that their opposing poles are of unlike polarity, and a second pair of diametrically opposed deflecting coils so connected that their opposing poles are of unlike polarity, adjacent poles of said pairs being of like polarity, said coils being so located that the axis of one pair of coils and the axis of the other pair of coils intersect at an angle which is substantially greater than zero degrees but which is not greater than 45 degrees.

3. A deflecting device for a cathode ray tube, said device comprising a pair of diametrically opposed deflecting coils, a second pair of diametrically opposed deflecting coils, the axes of said pairs of coils intersecting at an angle of substantially 90 degrees, said coils being connected in series, vertical deflecting input leads connected to said series connected coils at diametrically opposed points whereby two adjacent coils are in parallel with the other two adjacent coils with respect to said leads, and horizontal deflecting input leads connected to said series connected coils at diametrically opposed points substantially 90 degrees from said first-mentioned points whereby two adjacent coils are in parallel with the other two adjacent coils with respect to said horizontal deflecting leads, said coils being wound in such direction that current supplied through either said vertical deflecting input leads or through said horizontal deflecting input leads causes opposing poles of diametrically opposed coils to be of opposite polarity.

4. A deflecting device for a cathode ray tube, said device comprising a magnetic core having at least eight pole-pieces located in four diametrically opposed pairs, a deflecting coil on each of said pole-pieces, said coils being connected in series to form a closed ring circuit, vertical deflecting input leads connected at diametrically opposed points on said ring circuit, and horizontal deflecting input leads connected at diametrically opposed points on said ring circuit which are substantially 90 degrees from said first-mentioned points, said coils being wound in such direction that current supplied through either said vertical deflecting input leads or through said horizontal deflecting input leads causes opposing poles of diametrically opposed coils to be of opposite polarity.

5. A deflecting device for a cathode ray tube, said device comprising a magnetic core having at least eight pole-pieces located in four diametrically opposed pairs, one pair of diametrically opposed pole-pieces being the main vertical deflecting pole-pieces, another pair of diametrically opposed pole-pieces being substantially 90 degrees from said main vertical deflecting pole-pieces and being the main horizontal deflecting pole-pieces, the remaining pole-pieces being correcting or shading pole-pieces, vertical deflecting coils on said main vertical deflecting pole-pieces and on said shading pole-pieces, said vertical deflecting coils being connected to produce a vertical deflecting field in response to vertical deflecting current supplied thereto through a pair of leads, and horizontal deflecting coils on said main horizontal deflecting pole-pieces and on said shading pole-pieces, said horizontal deflecting coils being connected to produce a horizontal deflecting field in response to horizontal deflecting current supplied thereto through a second pair of leads.

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