April 12, 1949. E. W. BULL ET AL 2,467,009

CIRCUIT ARRANGEMENT EMBODYING CATHODE-RAY TUBES

Filed Dec. 12, 1946

Fig. 1.

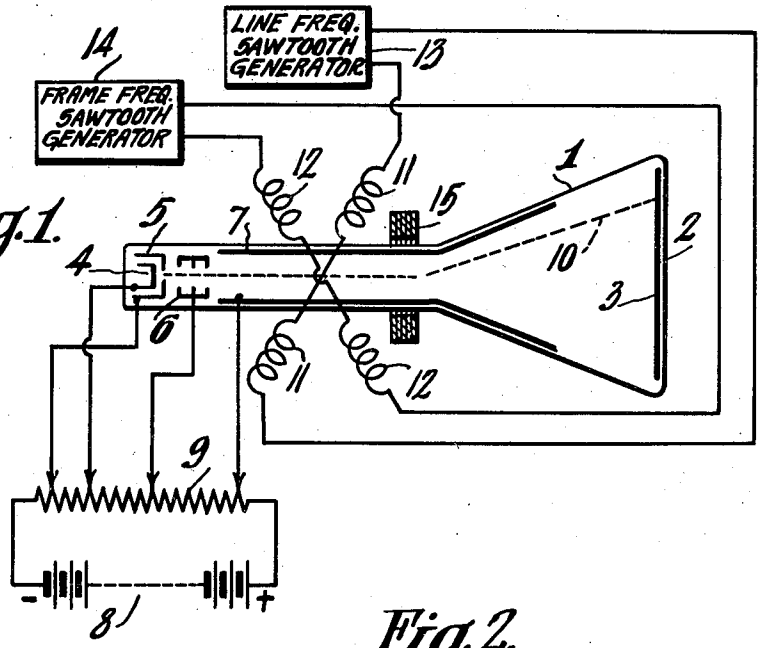


Fig. 2.

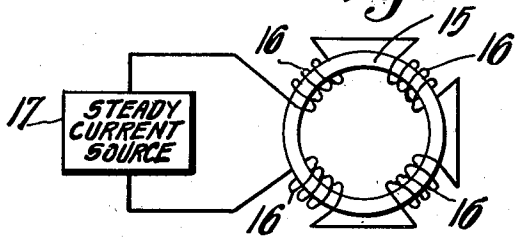
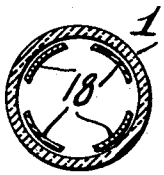


Fig. 3.



INVENTORS
ERIC WILLIAM BULL
& MAX ERIC PEMBERTON
BY
H. G. Grover
ATTORNEY

Patented Apr. 12, 1949 2,467,009

UNITED STATES PATENT OFFICE

2,467,009

CIRCUIT ARRANGEMENT EMBODYING CATHODE-RAY TUBES

Eric William Bull, Hounslow, and Max Eric Pemberton, Hayes, England, assignor to Electric & Musical Industries Limited, Hayes, England, a company of Great Britain

Application December 12, 1946, Serial No. 715,670
In Great Britain July 28, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires July 28, 1965

3 Claims. (Cl. 250—161)

1

This invention relates to circuit arrangements embodying cathode ray tubes in which the electron beam of the tube is required to be deflected over a surface within the tube.

In cathode ray tubes employed for television reception the fluorescent screen of the tube is usually provided on the end wall of the tube, said end wall usually being made as flat as possible in order to avoid distortion of the optical image reproduced in the screen. Also in cathode ray tubes employed for television transmission purposes the mosaic screen of the tube is usually flat. In deflecting the cathode ray beam over the surface of such screens it is usually the practice to employ two mutually perpendicular scanning fields and whilst it is possible to cause the scanning beam to trace out a truly rectangular patch on the screen providing that the screen has a surface which approximates to that of a sphere the centre of which is the point about which deflection of the beam occurs, it is found that when the screen is not curved in such a manner the scanned patch is no longer rectangular but is distorted. In cases where the screen is flat or of less curvature than the aforesaid sphere the scanned patch has a pincushion shape and in cases where the screen has a curvature greater than that of said sphere the scanned patch has a barrel shape. In order to correct for distortion of the scanned patch it has been the practice to vary the waveform of the current or voltage employed for deffecting the beam or in the case of electromagnetic scanning so to dispose the conductors of the scanning coils that a field is produced which diminishes in intensity from the axis of the tube. Although distortion of the scanned patch can be reduced in this manner, it is found, however, that the variation in field intensity is such that considerable aberration or variation of focus of the cathode ray beam occurs at large angles of deflection.

The main object of the present invention is to provide a circuit arrangement embodying a cathode ray tube in which improved means are provided for reducing distortion of the scanned object.

According to the invention a circuit arrangement is provided embodying a cathode ray tube and means for deflecting the beam of said tube so that it can be caused to scan a patch on the

2

screen of said tube which patch would be rectangular if the screen had a curvature corresponding to that of a sphere having as its centre the point about which deflection of said beam occurs and wherein the screen has a curvature which is greater or less than that of said sphere and is arranged normally to the axis of said beam and wherein there is provided means for setting up between said screen and said point a field which increases in intensity outwardly from its axis so as to reduce substantially or eliminate either pincushion or barrel distortion which would occur in the absence of said field.

Preferably said field is circularly symmetrical about the axis of the beam in its undeflected position, and whilst such a field is preferred approximately circularly symmetrical fields can be employed.

The deflecting means employed may be either electrostatic or electromagnetic or a combination of both electrostatic and electromagnetic means and the means for setting up said field may also be electrostatic or electromagnetic.

In order that the said invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings, in which—

Figure 1 illustrates diagrammatically a circuit arrangement according to one embodiment of the invention employing electromagnetic means for setting up said field,

Figure 2 is an end elevation on an enlarged scale of electromagnetic means for setting up said field, and

Figure 3 illustrates electrostatic means for setting up said field.

In Figure 1 of the drawings the reference numeral 1 indicates a cathode ray tube having a substantially flat end wall 2 on which is provided a fluorescent screen 3. The tube contains a cathode 4, a cathode screen 5, a first anode 6 and a second anode 7, these electrodes being fed in known manner with suitable potentials derived from a source of potential indicated conventionally by a battery 8 across which is provided a potentiometer 9 to which said electrodes are connected. The electron beam which is generated by the cathode 4 and focussed and accelerated by the electrodes 5, 6 and 7 and which may be modulated by applying suitable modulating po-

tentials to the electrode 5 is indicated by the dotted line 10 and is caused to trace out a patch on the fluorescent screen 3 by deflecting the beam in two co-ordinate directions. As shown in Figure 1, the means for deflecting the beam comprises two sets of coils 11 and 12 which are fed with suitable currents which, if the tube 1 is employed for television reception, are generated by line and frame frequency sawtooth generators 13 and 14. The deflecting means employed for deflecting the beam 12 are such that if the screen 3 were disposed on the surface of a sphere having as its centre the point about which deflection of the beam occurs, the beam would trace out a truly rectangular patch on the screen. The present invention is, however, concerned with cases in which the screen 3 conforms to a surface which has a curvature which is greater or less than that of said sphere which of course includes the case in which the screen conforms to a flat surface and in which the screen is disposed substantially normally to the axis of the beam when undeflected. In such cases if the beam is deflected over the surface of the screen either pincushion or barrel distortion occurs in the scanned patch.

In one form of the invention in order to overcome said distortion which, where a flat screen is employed as in Figure 1 the scanned patch will have a pincushion shape, electromagnetic means are provided for setting up a field between the scanning means and the screen 3, said means for setting up said field being preferably disposed close to said scanning means. Preferably the field set up is circularly symmetrical about the axis of the beam in its undeflected position. Such a field is approximated by the arrangement shown in Figure 2. As shown in this figure the means for setting up said field comprises a circular ring of soft iron 15 which is preferably of laminated construction and is provided with four coils 16 in series-aiding connection wound toroidally about symmetrically-disposed 45° segments of the ring 15. The ring 15 is arranged to surround the path of the beam as shown in Figure 1 and the axis of the ring is arranged coincident with the axis of the beam in its undeflected position and the coils are arranged substantially opposite to the corners of the scanned patch. The coils 16 may be fed with a steady current from a source 17 and the coils are so arranged that they set up within the ring 15 a field which increases in intensity outwardly from its axis. In one specific example of the invention the end wall 2 of the cathode ray tube 1 has a diameter of 12" and said end wall is substantially flat. The ring has an internal diameter of 2½" and an external diameter of 3" and is ½" thick. Each coil is wound over 45° of the ring with 35 turns and may be fed with a steady current of 0.6 ampere. It is found that by employing such a field the electron beam can be caused to trace out a substantially rectangular patch on the screen of the tube and that aberration of the cathode ray beam is reduced and that the focus of the beam can thereby be maintained substantially constant throughout the scanning movement of the beam. The desired amount of correction imparted by the field can be adjusted by varying the steady current passing through said coils.

The angle over which each toroidal coil is wound can be varied according to the correction required in individual cases, and, in general, where a high order of accuracy is required adjustment of the current in each individual coil can be effected.

In cases where it is desired to correct for barrel distortion the arrangement described above may be employed but in such cases the direction of current flow through the coils 16 will be in the opposite direction to that required for correcting pincushion distortion. Further, pincushion distortion can be corrected by changing the position of the coils relatively to the corners of the scanned patch and employing the same direction of current flow as in the case for correcting barrel distortion and vice versa. An arrangement of coils other than that shown in Figure 2 may be employed.

Instead of employing electromagnetic means for setting up said field, electrostatic means may be employed. As shown in Figure 3, said electrostatic means may comprise four electrodes 18 which may be disposed on the wall of the tube 1 and suitably spaced or separated from the second anode 7, the electrode 18 being equi-distantly arranged around the circumference of the tube and conform to the shape of a circular ring and extend over segments of the circumference of said ring somewhat less than 45°. Said electrodes are disposed substantially opposite to the corners of the scanned patch and to correct for pincushion distortion said electrodes will be fed with a suitable voltage which is negative with respect to the potential applied to the second anode 7 so as to set up a field which increases in intensity outwardly from its axis. The field set up approximates to a circularly symmetrical field that is to say a field the lines of which are circles concentric with the beam in its undeflected position. For correcting barrel distortion potentials positive with respect to the potential applied to the second anode 7, should be applied to the electrodes 18.

Instead of applying a steady current or voltage to the coils 16 or the electrodes 18, a varying current or voltage may be employed depending on the form of the correction desired. For example, by feeding the coil 16 or the electrodes 18 with a current or voltage of sawtooth waveform, the field in the region through which the beam is passing at any particular period during the deflecting cycle can be adjusted so as to give an effect equivalent to a constant field of any desired law. The varying current or voltage can of course be employed in conjunction with a steady current or voltage.

Although the invention has been described above as applied to a cathode ray tube employing a fluorescent screen, it will be understood that the invention is not limited thereto since it can be applied to other types of cathode ray tubes, such as those employing mosaic screens used in television transmitting tubes, such screens being usually supported in the tube independently of the end wall of the tube.

What we claim is:

1. In cathode ray apparatus wherein there is provided a cathode ray tube having means for developing, deflecting, and directing a cathode ray beam toward a target area and in which the radius of curvature of the target differs from the distance from the point of deflection of the beam to the target, a plurality of beam influencing means positioned adjacent said deflecting means and spaced apart equidistantly a pre-determined number of electrical degrees, and means for energizing said beam influencing means to produce a circularly symmetrical field about the axis of the beam in its undeflected position and which in-

creases in intensity outwardly from the axis of the beam.

2. Apparatus in accordance with claim 1 wherein said plurality of beam influencing means comprising a plurality of windings each spaced apart from the other by 45 electrical degrees and all energizing a core member of toroidal shape.

3. Apparatus in accordance with claim 1 wherein said beam influencing means comprise electrostatic plates spaced apart 45° from each other.

ERIC WILLIAM BULL.
MAX ERIC PEMBERTON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,157,182	Maloff	May 9, 1939
2,164,931	Maloff	July 4, 1939
2,165,803	Maloff	July 11, 1939
2,230,111	Gunther	Jan. 28, 1941
2,258,643	De Gier et al.	Oct. 14, 1941
2,264,567	Gunther	Dec. 2, 1941
2,406,740	Buckbee	Sept. 3, 1946