

The present invention relates to a circuit arrangement for the correction of geometrical distortions on the screen of a cathode ray tube by coupling an additional current into the vertical deflection winding.

In colour picture tubes, visible geometric aberrations of the reproduced raster occur due to the fact that the centre of curvature of the screen surface and the centre point for the electron beam deflection are located very far apart. There thus result e.g. pin-cushion aberrations in the North-South and the East-West direction which have to be eliminated by the provision of known correcting circuit means. For the elimination of the so-called tangential aberrations, a resonant circuit tuned to 37 kHz is inserted into the horizontal deflection circuit which causes a magnification in the region of the middle of the lines and a reduction of the deflection at the beginning of the lines and at the end of the lines.

For the elimination of pin-cushion aberrations, a correcting current is coupled into the vertical deflection circuit which current is usually a cosine waveform and modulates the vertical deflection current.

An aberration known by the term gull-wing manifests itself by a distortion of the lines in the form of a gull's wing which appears in the middle of the lower and upper halves of the picture. A cosine correcting current having double the line frequency, which is made zero in the upper, in the middle and the lower region of the picture, eliminates this aberration. For the elimination of this gull-wing aberration, there serves a circuit arrangement in accordance with the patent application WO-A-86/00170 for example.

In picture tubes having an extremely flat screen and a rectangular shape, a further geometrical aberration becomes painfully apparent. It appears additionally in the regions of the gull-wing aberration. Even after the elimination of the gull-wing aberration, it is still present and manifests itself in that the lines are curved at the beginning and at the end. The bending of the lines happens during the first and last approximately 5 microseconds of a line. The lines are curved downwardly in the upper half of the picture and upwardly in the lower half of the picture. The current required for the correction of this geometrical distortion thus has to have opposed directions during the two halves of the picture. For the correction of this bending aberration, a rising correcting current is needed at the end of the line and a falling correcting current at the beginning of the line. The circuit in

accordance with the specification WO-A-86/00170 cited above does not take this aberration into consideration however.

The object of the invention is to eliminate the bending aberration caused by the deflection field specific to this tube and thus to further improve the quality of a picture on a picture tube having an extremely flat screen. This object is achieved by the invention defined in the claim.

The invention will be explained hereinafter by means of an embodiment with the help of the drawing.

Figure 1 shows a block circuit diagram for carrying out the noted method for the elimination of the geometrical aberration described above

Figure 2 shows a detailed circuit diagram as an embodiment of the block circuit diagram in accordance with Fig. 1

Figure 3 shows the diagrams for explaining the circuit diagram in accordance with Figure 2.

A basic circuit construction with which the posed problem of eliminating the bending aberration can be solved is illustrated in Figure 1. It is concerned with a circuit arrangement with which the required correcting current is generated. The vertical deflection current, upon which the correcting current is superimposed and which is generated by the vertical deflection circuit 2, flows through this deflection winding 1. The correcting current is coupled in via a transformer 3 whose secondary winding 4 is in series with the deflection winding 1. The transformer 3 has a primary winding 5 which has a centre tap that is at the operating voltage UB . The two ends of the primary winding 5 are connected symmetrically to a respective amplifier 6 and 7 operating in the D mode. Both amplifiers work in the same way whereby e.g. the amplifier 6 is active during the upper half of the picture and the amplifier 7 during the lower half of the picture. Due to the amplifiers 6 and 7 operating in the D mode, the power consumption required for the generation of the correcting current is extremely small. The amplifiers 6 and 7 are driven by horizontal frequency pulses H which can also be additionally modulated in their width at the vertical frequency. These pulses are generated by pulse width modulators 8 and 9 which are activated alternately during the upper and lower halves of the picture. This is achieved in that the stages 8 and 9 are rendered conductive by oppositely phased vertical frequency signals from a modulator circuit 10. For the purpose of generating the drive signal for the amplifiers 6 and 7, there

is produced from a horizontal frequency pulse H in a sawtooth generator 11, a sawtooth voltage which is converted in a circuit 12 into a parabolic voltage that serves for driving the pulse width modulators 8 and 9.

For the explanation of the method of operation of the circuit in accordance with Figure 1, this will be explained on the basis of a detailed circuit diagram with the help of Figure 2. The diagrams in accordance with Figure 3 serve for supplementing the description of Figure 2 at the points indicated there.

A line frequency H pulse (Figure 3a) passes through the resistor 13 and is limited with the help of the Zener diode 14 and differentiated with the help of the capacitor 18 and the resistor 19. A short pulse reaches the transistor 21 of the sawtooth generator 11 via the resistor 20 so that the capacitor 22 is discharged via the resistor 23 which had been previously charged up by the operating voltage UB via the resistor 24. The sawtooth voltage (Figure 3b) is converted into a parabola (Figure 3c) in the parabolic voltage generator 12 which consists of the transistor 25, the resistors 26, 27, 28, 29, 30 and 31 and the capacitors 32, 33 and 34. In a further differentiating circuit 15, 16, 17, there arises on the resistor 17, the differentiated H pulse whose positive component is supplied via the resistor 35 and the diode 36 to the emitter of the transistor 25 so that this is blocked at the beginning of the line flyback. For the purpose of making the parabola symmetrical, there serves the resistor 31 which, to this end, is made adjustable. The parabolic voltage generated in this way reaches the pulse width modulators 8 and 9 in parallel via the capacitors 37, 38 and the resistors 39 and 40. The working points of the pulse width modulators can be set by the resistance dividers 41, 42 and 43 as well as 44 and 45.

The transistors 46 and 47 of the pulse width modulators 8 and 9 are rendered active alternately by approximately triangular, vertical frequency, oppositely phased voltages. These voltages are generated in that a vertical frequency triangular signal is applied via the capacitor 49 and the resistor 50 to the base resistor 51 of an amplifier 53. The voltage arising on the collector resistor 54 is passed to a phase splitter circuit consisting of the transistor 55 and the resistors 56 and 57 and 52. The oppositely phased voltages reach the bases of the transistors 46 and 47 via capacitors 58 and 59 and resistors 60 and 61. The two transistors 46 and 47 have a common emitter resistor 48. The capacitor 62 is sufficiently low ohmic for line frequency currents but it cannot maintain the voltage alterations which are brought about by the vertical frequency

signal constant. Consequently, there arises on the resistor 63, a parabolic voltage having double the vertical frequency whose positive peaks occur at the beginning, in the middle and at the end of the vertical forward sweep.

The signal (Figure 3d) at the collector of the transistor 46 (47) is taken off from the collector resistor 64 (65) and reaches the base resistor 70 (71), to which a diode 72 (73) is connected in parallel for clipping the negative voltage peaks, via the resistor 66 (67) and the capacitor 68 (69). Switching voltages (Figure 3g) arise on the base resistors 70 and 71 so that the switching transistors 74 and 75 are rendered conductive. The transistor 74 is rendered conductive during the upper half of the picture and the transistor 75 during the lower half of the picture. Both transistors work as switches and apply the operating voltage U_B to earth potential (Figure 3f) via one half of the primary winding 5 of the transformer 3. The transistor 74 is rendered conductive at the end of the lines in the upper half of the picture and it builds up a rising magnetic field in the primary winding 5. This causes a rising current in the secondary winding 4 (Figure 3g) which is superimposed on the vertical deflection current in the vertical deflection winding 1. Shortly before the end of the flyback, the transistor 74, which was blocked during the first part of the flyback, is rendered conductive once more and then switched off again at the latest at the end of the flyback. Since the second switching-on happens during the flyback, the induced current has no visible effect. It rises again up to the pre-settable end value (Figure 3g). What is essential is that the current is switched off at the latest at the end of the flyback i.e. at the beginning of the horizontal forward sweep. The energy stored in the secondary winding 4 flows as a constantly falling additional correcting current into the deflection winding 1 and thus brings about the desired effect. The same applies for the transistor 75 which is responsible for the lines in the lower half of the picture. It has the contrary effect of an opposite correction since the currents through the centre tap of the primary winding 5 flow in the opposite direction. Damping resistors 76 and 77 across the transformer windings 5 and 4 prevent interfering decaying oscillations as a result of the unavoidable winding capacitances.



Claims

1. Circuit arrangement for the correction of geometrical distortions on the screen of a cathode ray tube by coupling an additional current into the vertical deflection winding, characterised in that, there are provided two switching stages (6; 7) operating in the D mode which are respectively connected to the ends of a primary winding (5) of a transformer (3) that is provided with a centre tap that is at operating potential (UB) and which, at a predetermined time point before the ending of the horizontal forward sweep of the electron beams {one} up to the beginning of the horizontal flyback of the electron beams and, at a predetermined time point before the ending of the horizontal flyback of the electron beams up to the beginning of the horizontal forward sweep of the electron beams, generate a steadily rising current and, after the switching stages (6; 7) switch off, a steadily falling current in the secondary winding (4) of the transformer (3) connected in series with the deflection winding (1) whereby, on each occasion, the rising or falling current occurring in the visible forward sweep of the electron beams serves as a correcting current and that the two switching stages (6; 7) are controlled in push pull at the vertical frequency, wherein the two switching stages (6; 7) are controlled by a respective pulse width modulator (8 or 9) and wherein the pulse width modulators (8, 9) generate horizontal frequency pulses and are rendered active alternately in the upper and lower halves of the picture by respective oppositely phased voltages.

2. Circuit arrangement in accordance with Claim 1, characterised in that, the predetermined time points occur at 5 to 10 microseconds.