

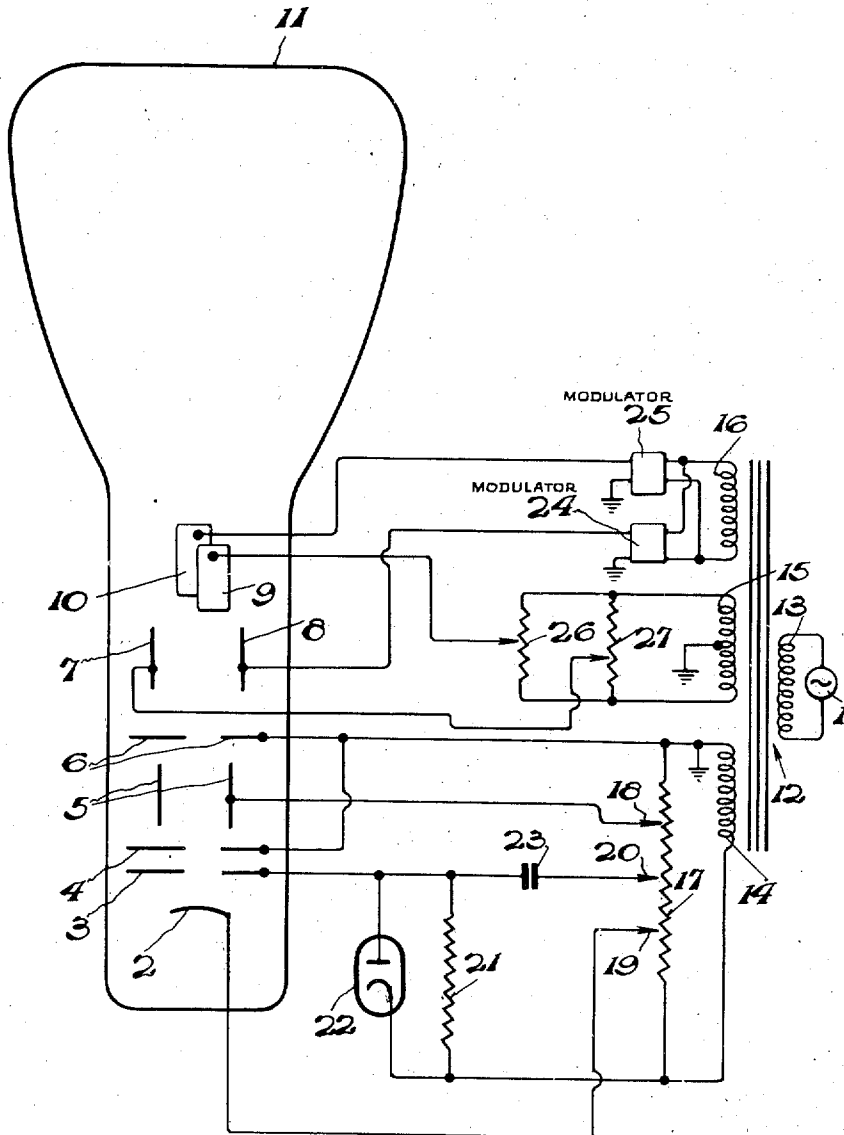
Dec. 21, 1948.

L. H. BEDFORD ET AL

2,456,809

CATHODE-RAY TUBE

Original Filed Nov. 30, 1943



INVENTORS
Leslie Herbert Bedford
John Bell
BY Eric Miles Langham
Lloyd Hall Sutton
attorney

UNITED STATES PATENT OFFICE

2,456,809

CATHODE-RAY TUBE

Leslie Herbert Bedford, London, and John Bell and Eric Miles Langham, Teddington, England, assignors to A. C. Cossor Limited, London, England, a British company

Original application November 30, 1943, Serial No. 512,402. Divided and this application July 26, 1946, Serial No. 686,476. In Great Britain November 30, 1942

14 Claims. (Cl. 315—14)

1

This invention relates to excitation circuits and deflection systems for cathode ray tubes.

Apparatus according to the invention comprises a cathode ray tube having a pair of deflector plates, means to excite the final anode of the gun and all other gun electrodes which substantially influence the focus with cophased alternating voltage relative to cathode, and means to apply between said deflector plates a cophased alternating voltage, whereby the focus is maintained and a deflection is produced proportional to the relative amplitudes of the deflection voltage and the final anode voltage.

According to a preferred form of the invention, apparatus for simultaneously displaying, by means of the co-ordinates of a spot position on the screen of a cathode ray tube, the amplitude of two cophased alternating voltages relative to that of a third cophased voltage, comprises means to apply said third voltage between the cathode and the final anode of the cathode ray tube gun and to apply suitable fractions thereof to all other gun electrodes which substantially influence the focus, and means to apply said first two voltages between successive pairs of deflector plates producing deflection in mutually perpendicular directions.

When the potential of the final anode of an electron gun is varied relative to cathode, the focus is maintained if the potentials relative to cathode of the focussing electrode, and of all other electrodes which influence the focus, are varied in proportion. If, therefore, all the electrodes of the gun are excited with alternating voltages relative to cathode in the same phase, then beam current will flow during every half cycle while the anodes are positive to cathode and the focus will be substantially correct throughout these half cycles. The focus is not, however, disturbed by the beam current control electrode and it is preferred in practice that this be maintained negative to cathode so as to suppress the beam for a period at each end of the half cycle. Very satisfactory operation is obtained if these periods of suppression are both of the order of one-sixth of a cycle, so that beam current will flow for the central one-third of the positive half cycle. This may be effected by holding the potential of beam current control electrode at an appropriate direct voltage negative to cathode.

A further refinement which may be employed alternatively or additionally, however, is to increase the beam current substantially, during the fraction of a cycle while it is permitted to flow, beyond the value which it would attain if the

2

beam current control electrode were maintained at constant potential negative relative to cathode. For this purpose it is preferred to superpose an alternating voltage between the beam current control electrode and the cathode, this being in phase with the voltages between the anodes and the cathode.

The angle of deflection of the electron beam is proportional to the potential difference between a pair of deflector plates, but is inversely proportional to the potential difference between the final anode of the electron gun and cathode. When, therefore, an alternating voltage is applied between a pair of deflector plates in phase with the alternating voltage between final anode and cathode, the spot where the beam impinges on the fluorescent screen is theoretically stationary. Its position is determined by the amplitude of the alternating deflection voltage, assuming that the amplitude of the alternating gun voltage remains constant.

The accompanying drawing shows a circuit diagram of a cathode ray oscillograph tube arranged for alternating current operation in accordance with the invention.

The cathode ray oscillograph tube has a cathode 2, a beam current control electrode 3, a first anode 4, a focusing electrode 5 and a final anode 6. These electrodes together form the electron gun. The electron beam leaving the final anode 6 passes between two pairs of electrostatic deflector plates, 7, 8 and 9, 10 which are arranged to produce deflections in mutually perpendicular directions. The beam finally impinges in a spot on the fluorescent screen 11.

The exciting and deflection voltages are all derived from the common alternating source 1, which may have a frequency of 50 cycles.

Transformer 12, which has its primary winding 13 connected across source 1, is provided with three separate secondary windings 14, 15, 16.

The electron gun is excited from winding 14. One end of this winding is earthed and connected to the final anode 6. A potentiometer 17 is connected across winding 14 and the alternating voltages for the other electrodes of the gun are derived from tappings thereon. Thus the focusing electrode 5 and the cathode 2 are connected to tappings 18 and 19 respectively. The first anode 4 is shown as connected directly to the final anode 6; but if the gun is so designed that this first anode would ordinarily, with direct voltage excitation, be excited at a potential negative with respect to the final anode, then this first anode

4 should also be connected to a tapping on potentiometer 17.

The beam current control electrode 3, which in normal direct voltage operation is maintained negative to cathode, may, in the arrangement according to the invention, be excited with alternating voltage or direct voltage, but it is preferably excited with a combination of both. In the arrangement shown it is excited relative to cathode with an alternating voltage drop derived from potentiometer 17 superposed on a direct voltage established across resistance 21. This resistance 21 is the load of a diode rectifier 22, which is connected through coupling condenser 23 between tapping 20 and the end of potentiometer 17 remote from earth.

The deflection voltages are derived from secondary winding 16, and their amplitudes are modulated, in accordance with phenomena to be represented, by modulators 24 and 25 respectively. These voltages are shown as applied asymmetrically to deflector plates 8 and 10, only shift voltages being applied to the opposite plates 7 and 9. These shift voltages, also taking the form of alternating voltages in phase with those applied to the electron gun, are derived from tapings on potentiometers 26, 27, connected across the secondary winding 15, which has an earthed centre-tap. The deflection voltages may, however, be applied symmetrically, with or without the superposition of shift voltages, if this is preferred.

The arrangement may be regarded as inherently a demodulator; the two co-ordinates of the position of the spot on the screen represent the amplitudes of the output voltages from modulators 24 and 25. The position is independent of the voltage and frequency of the source 1.

In comparison with results which can be obtained by demodulating an alternating voltage which is modulated in amplitudes, and by then exhibiting the modulation on a cathode ray tube excited with direct voltage in the ordinary way, this system provides, in addition to other advantages, a feature of sense indication. So long as the output voltage from modulator 24 is in phase with the voltage of final anode 6 relative to cathode, the beam will be deflected towards the deflector plate 8. If, however, the modulation is carried through zero and beyond, so that the output voltage of modulator 24 is in anti-phase with that of the final anode relative to cathode, the deflection of the beam is towards deflector plate 7.

It will be evident that the invention is not limited to use in oscillograph tubes, and the term "cathode ray tube" is, therefore, to be understood as including beam deflection valves.

This application is a division of application Serial No. 512,402, filed November 30, 1943.

We claim:

1. Apparatus comprising a cathode ray tube having a pair of deflector plates, means to excite the final anode of the gun and all other gun electrodes which substantially influence the focus with cophased alternating voltage relative to cathode, and means to apply between said deflector plates a cophased alternating voltage, whereby the focus is maintained and a deflection is produced proportional to the relative amplitudes of the deflection voltage and the final anode voltage.

2. Apparatus for simultaneously displaying, by means of the co-ordinates of a spot position on the screen of a cathode ray tube, the amplitudes of two cophased alternating voltages relative to

that of a third cophased voltage, which comprises means to apply said third voltage between the cathode and the final anode of the cathode ray tube gun and to apply suitable fractions thereof to all other gun electrodes which substantially influence the focus, and means to apply said first two voltages between successive pairs of deflector plates producing deflection in mutually perpendicular directions.

3. Apparatus according to claim 1, comprising means to suppress the electron beam for periods at both ends of each half cycle when the final anode is positive to cathode.

4. Apparatus according to claim 3, wherein each of said periods of suppression is of the order of one-sixth of a cycle.

5. Apparatus according to claim 3, wherein said suppression means comprises means to apply a direct negative voltage bias to the beam current control electrode.

6. Apparatus according to claim 1, comprising means to excite the beam current control electrode with a further cophased alternating voltage relative to cathode to increase the beam current when flowing.

7. Apparatus according to claim 2, comprising means to suppress the electron beam for periods at both ends of each half cycle when the final anode is positive to cathode.

8. Apparatus according to claim 2, comprising means to suppress the electron beam for periods at both ends of each half cycle when the final anode is positive to cathode, each of said periods being of the order of one-sixth of a cycle.

9. Apparatus according to claim 2, comprising means to suppress the electron beam for periods at both ends of each half cycle when the final anode is positive to cathode, said suppression means comprising means to apply a direct negative voltage bias to the beam current control electrode.

10. Apparatus according to claim 2, comprising means to excite the beam current control electrode with a further cophased alternating voltage relative to cathode to increase the beam current when flowing.

11. Cathode ray tube apparatus comprising a cathode, a beam current control electrode, a focussing electrode, and a plurality of anodes forming an electron gun for producing an electron beam, two pairs of electrostatic deflector plates for producing deflections of said beam in mutually perpendicular directions, a fluorescent screen on which said beam impinges, and means for impressing cophased alternating current directly upon all of said electrodes, said current being derived directly from a common source of alternating current.

12. Cathode ray tube apparatus as defined in claim 10 having means for exciting the beam current control electrode with direct current on which is superimposed alternating current derived from the common source.

13. Cathode ray tube apparatus as defined in claim 10 having modulators through which symmetrical deflection voltages are applied to said deflector plates, said modulators deriving current from the common source of alternating current.

14. Cathode ray tube apparatus as defined in claim 10 having modulators and potentiometers for applying asymmetrical deflection voltages to said deflector plates, a modulated voltage derived from the source of alternating current through a modulator being applied to one de-

2,456,809

5

deflector plate of each pair and a shift voltage derived from the source of alternating current through a potentiometer being applied to the other deflector plate of each pair.

LESLIE HERBERT BEDFORD. 5
JOHN BELL.
ERIC MILES LANGHAM.

REFERENCES CITED

The following references are of record in the 10
file of this patent:

6

UNITED STATES PATENTS

Number	Name	Date
2,089,430	Roys et al.	Aug. 10, 1937
2,161,305	Messner	June 6, 1939
2,318,197	Clark	May 4, 1943
2,391,862	Boyle	Jan. 1, 1946
2,419,550	Hardy	Apr. 29, 1947