

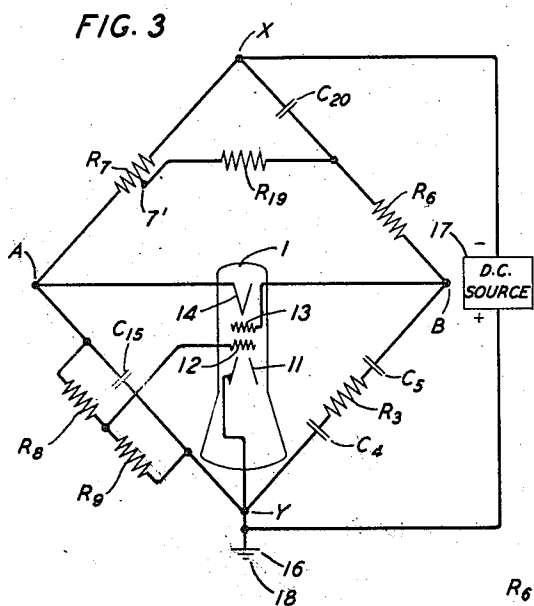
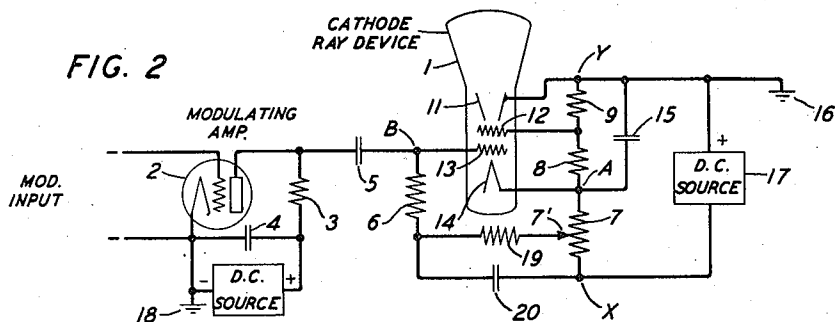
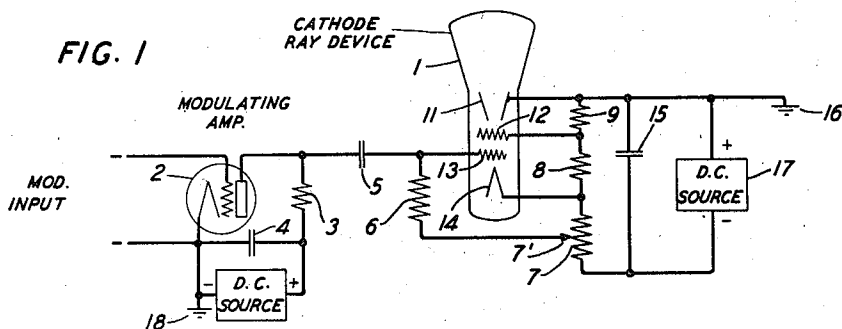
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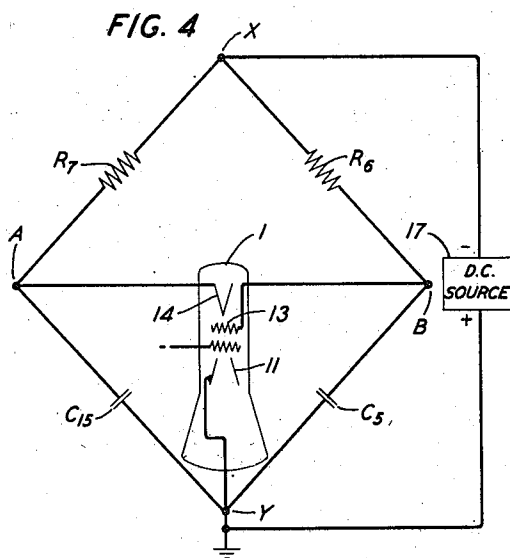
2,360,356

CATHODE RAY TUBE CIRCUIT

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$$R_6 C_5 = R_7 C_{15}$$



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CATHODE RAY TUBE CIRCUIT

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This invention relates to cathode ray devices and more particularly to beam control circuits therefor.

In cathode ray devices and in particular those devices wherein deflection of the beam is produced by electrostatic means it is necessary to maintain the deflecting plates at the same direct current potential as the accelerating electrode. To ease the requirements for the deflecting amplifier circuit it has been the customary practice to operate both the accelerating electrode and the deflecting electrodes at direct current ground potential. This makes it necessary to operate the cathode and the other control electrodes comprising the electron gun at a relatively high negative potential. To successfully do this for circuits where a beam intensity modulator is used it has been necessary to have the power supply closely regulated to prevent fluctuations in power supply voltage. Such variations modulate the beam by reason of the fact that the beam intensity control electrode or grid is often coupled to ground through a relatively low impedance path so that the power supply variations are impressed effectively between the cathode and the beam control electrode. In many systems power supply voltage variations of only two per-cent will completely modulate the spot intensity. Where cathode ray devices are to be operated at a plurality of different voltages or where it is desired to dispense with closely regulated high voltage power supply systems, it is necessary to arrange the cathode ray circuit so that it is substantially insensitive to these power supply variations.

It is the object of this invention to provide a circuit for the electron gun of a cathode ray device which is substantially insensitive to voltage variations of the power supply circuit.

The foregoing object is attained by this invention which provides a circuit comprising an alternating current bridge having two pairs of terminals, the direct current power supply being connected to one pair of said terminals, the accelerating electrode being connected to the bridge terminal which is connected to the positive pole of the power supply, and the cathode and beam intensity control electrode being connected to the other pair of bridge terminals.

The invention may be better understood by referring to the accompanying drawing in which:

Fig. 1 is a circuit typical of many cathode ray devices of the prior art;

Fig. 2 discloses the circuit of Fig. 1 modified to embody this invention;

Fig. 3 is a circuit showing in conventional bridge form the part of Fig. 2 embodying this invention; and

Fig. 4 is a circuit showing only those elements of Fig. 3 which are active in forming the balanced bridge structure.

Referring now more particularly to Fig. 1 it will be noted that the cathode ray device 1 includes as parts thereof an accelerating electrode 11, a positive control electrode 12, a negative beam intensity control electrode 13 and a cathode 14, these elements comprising an assembly commonly called an electron gun. Additional elements, not shown, are also supplied in a variety of forms well known to the art and depending upon the specific use to which the device is to be put.

In order to control the beam intensity a modulating amplifier 2 may be provided having an output resistor 3. The alternating current component developed across resistor 3 is applied to beam intensity control electrode 13 of cathode ray device 1 through a coupling condenser 5. Normal direct current bias of electrode 13 is provided through resistor 6 from potentiometer 7 and may be adjusted by moving slider 7'. Suitable voltages are applied to the other electrodes of cathode ray device 1 through a voltage divider network comprising resistors 7, 8 and 9, the source of this voltage coming from a direct current supply 17. A filter condenser 15 is connected across the divider network as shown.

The accelerating electrode 11 must be positive with respect to cathode 14 and as it is customarily the most positive of all the electrodes, it is connected to the positive pole of source 17. In order to maintain the accelerating electrode 11 at ground potential, the positive end of source 17 is grounded at 16.

For most cathode ray devices it is necessary to maintain a potential difference of several thousand volts between accelerating electrode 11 and cathode 14. The impedance of the path from electrode 13 through condenser 5, resistor 3, condenser 4 to ground 18 is relatively low. This low impedance path from control electrode 13 to ground effectively maintains this electrode at ground potential in so far as fluctuations in the supply voltage are concerned. However, since the potential of the cathode 14 will fluctuate with respect to ground as the supply voltage varies, these variations in supply voltage will appear between the grid 13 and cathode 14.

The result is that unless the power supply is very carefully regulated, an intolerable variation in beam intensity will take place even for fluctuations of the order of one per cent of the steady direct current voltage. This invention is directed to the elimination of this unwanted modulation effect.

In Fig. 2 a circuit in accordance with this invention is disclosed which eliminates this unwanted modulation effect. This circuit differs from Fig. 1 primarily in that an additional high resistance 19 and a condenser of relatively large capacity 20 have been inserted in the bias circuit for beam control electrode 13. Also the lower end of filter condenser 15 has been connected directly to cathode 14 rather than to the lower end of bias control potentiometer 7. It will be observed that these changes have transformed the circuit into the form of an alternating current bridge having one pair of terminals X, Y to which the power supply 17 is connected and another pair of terminals A, B to which are connected cathode 14 and beam control electrode 13, respectively. When this bridge network is properly balanced fluctuations in voltage from power supply 17 being impressed on terminals X, Y will have no effect on the voltage applied to beam control electrode 13 with respect to cathode 14 since these latter two electrodes are connected across the other pair of bridge terminals.

To better understand the circuit of Fig. 2 it has been redrawn in conventional bridge form in Fig. 3. In this figure terminals X, Y and A, B are as shown in Fig. 2. Also the various elements of cathode ray device 1, grounds 16 and 18 and power supply source 17 bear the same reference numerals as in Fig. 2. The various subscript numerals for the various resistors and condensers in the bridge network correspond with the similarly numbered elements in Fig. 2. For example, resistor 6 in Fig. 2 is denoted R_6 in Fig. 3. This bridge network is balanced when the following equation is satisfied:

$$R_6 C_5 = R_7 C_{15} \quad (1)$$

It will be readily understood that this is so when it is remembered that the impedance of condenser 20 is small compared with the resistance of resistor 6, that the impedance of the series-connected resistor 3 and condenser 4 is small compared with the impedance of condenser 5 and that the resistance of series-connected resistors 8 and 9 is very large compared with the impedance of condenser 15. Also since the resistance of resistor 19 is very large, it has a negligible effect on the balance of the bridge.

It will be observed that although the voltage fluctuations from source 17 will have no effect whatever upon the voltage of beam control grid 13 with respect to cathode 14, adjustments of slider 7 will still provide the desired adjustments of the direct current bias of beam control grid 13. It will also be evident that voltage variations appearing across resistor 3 will be effectively impressed between cathode 14 and beam control grid 13 through series-connected condensers 4, 5 and 15 represented in Fig. 3 by capacities C_4 , C_5 and C_{15} .

Fig. 4 shows the invention stripped of all of the impedance elements which have no appreciable effect on the balanced condition of the network. It will be seen that the alternating current bridge is made up a simple network of resistances R_6 and R_7 and capacities C_5 and C_{15} .

It will be obvious to those skilled in the art that when the impedance elements have been so selected as to cause this bridge to be balanced that it will be balanced for all frequencies and that fluctuations in supply voltage impressed on terminals X, Y will not appear across terminals A, B.

What is claimed is:

1. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge balanced at substantially all frequencies, two of said terminals providing connections for the direct current power supply, and connections for connecting the cathode and the beam intensity electrode respectively to the remaining two terminals, whereby variations in the voltage of the direct current supply do not affect the voltage between said cathode and said beam intensity electrode.

2. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge balanced at substantially all frequencies, two of said terminals providing connections for the direct current power supply, a connection from the accelerating electrode to the bridge terminal which is connected to the positive pole of the power supply, and connections for connecting the cathode and the beam intensity electrode, respectively, to the remaining two terminals, whereby variations in the voltage of the direct current supply do not affect the voltage between said cathode and said beam intensity electrode.

3. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge having impedance elements balanced at substantially all frequencies, two of said terminals providing connections for the direct current power supply, connections for connecting the cathode and the beam intensity electrode respectively to the remaining two terminals, a direct current path from said cathode to said beam intensity electrode including a potentiometer for adjusting the direct current bias of said beam intensity electrode, said path also including a resistor shunting some of said bridge impedance elements the resistance whereof is high compared to the impedance of the bridge elements shunted thereby, whereby variations in the voltage of the direct current supply do not affect the voltage between the cathode and said beam intensity electrode.

4. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge having imped-

ance elements balanced at substantially all frequencies, two of said terminals providing connections for the direct current power supply, a connection from the accelerating electrode to the bridge terminal which is connected to the positive pole of the power supply, connections for connecting the cathode and the beam intensity electrode respectively to the remaining two terminals, a direct current path from said cathode to said beam intensity electrode including a potentiometer for adjusting the direct current bias of said beam intensity electrode, said path also including a resistor shunting some of said bridge impedance elements the resistance whereof is high compared to the impedance of the bridge elements shunted thereby, whereby variations in the voltage of the direct current supply do not affect the voltage between said cathode and said beam intensity electrode.

5. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge having impedance elements balanced at substantially all frequencies, a plurality of branches including said impedance elements interconnecting said four terminals, two of said terminals providing connections for the direct current power supply, connections for connecting the cathode and the beam intensity electrode respectively to the remaining two terminals, modulating means

for varying the voltage across at least one of the impedance elements in one of said branches to correspondingly vary the voltage between said cathode and said beam intensity electrodes, whereby variations in the voltage of the direct current supply do not affect the voltage between said cathode and said beam intensity electrodes.

6. In a circuit for stabilizing the beam intensity of a cathode ray device with respect to variations of the direct current power supply voltage, said device having an electron gun including as parts thereof accelerating and beam intensity electrodes and a cathode, the circuit comprising a four-terminal alternating current bridge having impedance elements balanced at substantially all frequencies, a plurality of branches for said bridge including said impedance elements interconnecting said four terminals, two of said terminals providing connections for the direct current power supply, a connection from the accelerating electrode to the bridge terminal which is connected to the positive pole of the power supply, connections for connecting the cathode and the beam intensity electrode respectively to the remaining two terminals, modulating means for varying the voltage across at least one of the impedance elements in one of said branches to correspondingly vary the voltage between said cathode and said beam intensity electrodes, whereby variations in the voltage of the direct current supply do not affect the voltage between said cathode and said beam intensity electrodes.

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