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POWER SUPPLY CIRCUIT

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Fig. 1

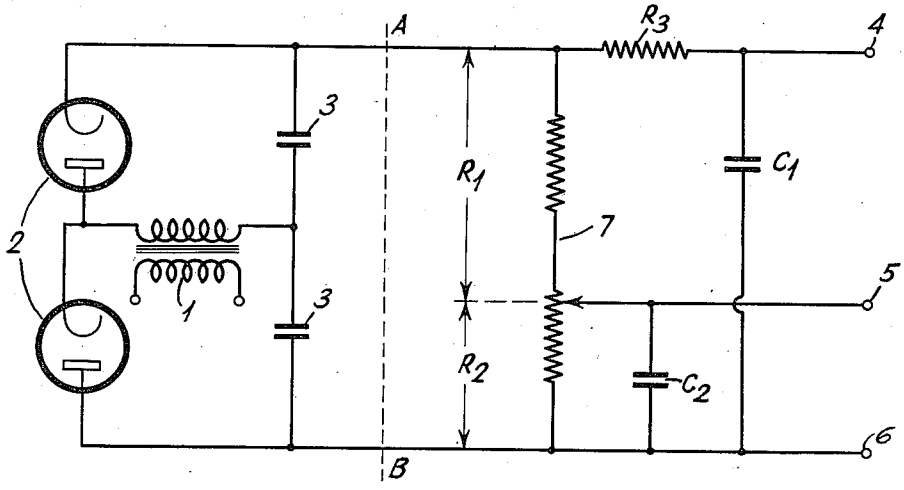
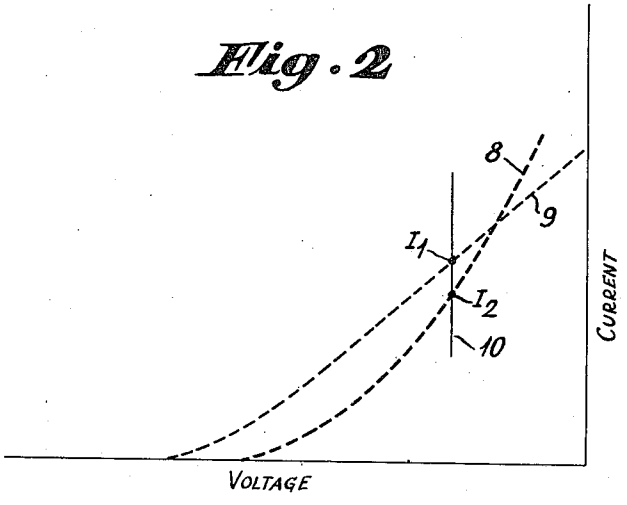


Fig. 2



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POWER SUPPLY CIRCUIT

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3 Claims. (Cl. 250—27)

This invention relates to high tension supply circuits for electron discharge devices and has particular reference to circuits for supplying high tension voltages to the anodes or focussing electrodes of cathode ray tubes.

Cathode ray tubes of the type employed in the reception of television transmission are usually provided with two anodes which assist in focussing the electron beam and which are frequently referred to as the first and second anodes, the former being nearer the cathode than the latter.

The focussing action depends upon the relative positions of the anodes and upon adjustment of the ratio of the voltages applied to them, relatively to the cathode. This ratio for good focus varies slightly over a wide range of anode voltages but for a small range of voltage change the ratio of voltage for good focus remains substantially constant. Conveniently, a high voltage which is applied usually to the second anode, may be obtained from a rectifier or other source of high voltage and a lower voltage which is applied to the first anode is derived from a potentiometer bridged across the source. In such an arrangement any variations of the voltage of the source affect both potentials by the same percentage so that the focussing ratio is maintained. On the other hand, any change in signal intensity will alter the current drawn by the anodes and thus the change of current of the anode at the lower potential will cause a change in that potential which is an incorrect fraction of the higher potential. The lower the resistance of the potentiometer the less will be the alteration of the lower potential due to such current variation. However, the provision of a comparatively low resistance potentiometer involves the supply of considerable high tension current and the consequent dissipation of heat.

In the specification of British Patent No. 410,478, a H. T. supply circuit for cathode ray tubes is disclosed in which the second anode is connected directly to the positive terminal of a source of supply and the first anode is supplied from a tapping point in a potentiometer resistance connected directly across the source of supply. One portion of the potentiometer resistance between the tapping point to the first anode and the negative terminal of the source is made variable in order to permit adjustment of the ratio of the potential differences between the anodes and the cathode, should the mean current between the first anode and the cathode vary. It is the object of the present invention to provide a potentiometer circuit arrangement for supplying H. T. voltages to the first anode of the cathode ray tube in such a manner that the focus may be maintained good for varying currents without involving the use of too low a value of potentiometer resistance.

According to the present invention in a circuit for supplying to electrodes of an electron discharge device, potentials which maintain a constant ratio, one electrode is fed from a source of potential and another electrode is fed from a tapping point in a potentiometer bridged across the source of potential, a resistance being inserted in the lead from the positive end of the potentiometer and the first mentioned electrode and serving to reduce variations of the potential ratio of the two electrodes caused by variation in current flowing to the second mentioned electrode. In a particular circuit according to the invention a condenser is connected across a portion of the potentiometer supplying one of the electrodes, and a second condenser is connected across the whole of the potentiometer and the resistance inserted in the positive potential supply lead.

In a supply circuit for a cathode ray tube embodying the invention, the second anode is supplied from a source of potential and the first anode is supplied with a lower potential than the second anode, said lower potential being obtained from a tapping point in a potentiometer bridged across the source of potential, a resistance being inserted in the lead from the positive end of the potentiometer and the second anode and serving to reduce variations of the potential ratio of the first and second anodes caused by variation in current flowing to the first anode. A condenser is connected across the portion of the potentiometer supplying the first anode and a second condenser is connected across the potentiometer and resistance inserted in the positive supply lead, the said condensers with the resistances across which they are connected having substantially equal time constants.

In order that the invention may be more clearly understood and readily carried into effect, a supply circuit embodying the invention will now be more fully described by way of example with reference to the drawing in which—

Fig. 1 shows such a supply circuit, and

Fig. 2 is an explanatory graphical diagram.

Referring to Fig. 1 of the drawing a source of potential is shown to the left of the dotted line, A, B constituted by a conventional voltage doubler rectifying circuit including a transformer 1, diode rectifiers 2, and condensers 3. A terminal

4 supplies high voltage to the second anode of a cathode ray tube (not shown in the drawing), the terminal 5 supplying the first anode of the tube while the terminal 6 is connected to the cathode of the tube. It will be understood that the cathode ray tube is operated in the conventional manner, a higher voltage being applied to the second anode than to the first, the gun current of the tube being subject to changes such as are produced by variations in signal intensity due for example, to variations in picture brightness. A cathode dropping resistance may if necessary be connected between the terminal 6 and the cathode of the tube.

A potentiometer resistance 7 comprising series connected resistances R_1 and R_2 is connected directly across the terminals of the rectifying circuit and a fixed resistance R_3 is connected between the terminal 4 and the high potential end of the potentiometer 7.

A condenser C_1 is connected directly across the terminals 4 and 6 and a further condenser C_2 is connected across the terminals 5 and 6.

Assuming that the focussing ratio is represented by k, then

$$k=\frac{R_1+R_2}{R_2}$$

approximately.

In Fig. 2 the curves 8 and 9 represent the current drawn by the first and second anodes respectively, plotted against voltages applied to the grid of the cathode ray tube. The vertical line 10 represents the maximum grid potential swing to be expected under normal working conditions so that the current values represented by I_1 and I_2 are the maximum currents to be expected. It will be noted that these currents do not bear a strict ratio to each other but nevertheless follow roughly similar curves.

Let it now be assumed that the anode currents drawn by the tube change from zero to the values I_1 and I_2 and that this change causes no appreciable change in the voltage from the high tension source. The potential of the second anode will then remain the same assuming R_3 to be absent. The potential of the first anode will fall by

$$I_1\frac{R_1R_2}{R_1+R_2}$$

volts and there will be a consequent departure from the ratio k of the volts applied to the first and second anodes. If the resistance R_3 is equal to

$$\frac{l_1}{l_2}k\frac{(R_1R_2)}{(R_1+R_2)}$$

the second anode current I_2 will cause a voltage drop given by

$$l_2\frac{(l_1)}{l_2}k\frac{(R_1R_2)}{(R_1+R_2)}=l_1\frac{(R_1R_2)}{(R_1+R_2)}k$$

which is k times the drop of the first anode and hence the voltage ratio will be maintained. It is not necessary for the H. T. supply voltage to be unaffected by the currents drawn by the first and second anodes in the case assumed since any change of the H. T. voltage will affect the voltages of the first and second anodes in proportion. The maintenance of the ratio k will not be so good for other values of current drawn by the first and second anodes since these currents are not exactly proportional. When they are roughly proportional the resistance R_3 maintains the ratio more nearly correct than if it were not used.

The voltage supplied to the terminal 5 is derived from an adjustable tapping point in the portion R_2 of the potentiometer resistance 7 in order to permit adjustment of the voltage applied to the first anode to suit the particular cathode ray tube being used. Variation of the voltage applied to the first anode will vary the value required for the resistance R_3 and the value of this resistance may be selected to suit the cathode ray tube. Alternatively, the expedient adopted in British Patent No. 410,478 may be applied in the present case, the resistance R_2 being more variable. In this case it is not necessary to alter the value of resistance R_3 provided

$$\frac{I_1}{I_2}$$

remains constant.

When the currents drawn by the first and second anodes vary rapidly there will be corresponding potential variations, and the condensers C_1 and C_2 are included in order to absorb such rapid potential variations. If these condensers are large, only changes in general picture brightness will affect the average anode current drawn from the potentiometer. As the changes to be expected in average anode current are not as large as the quick changes constituting the picture, the introduction of the condensers lessens any remaining alteration of focussing ratio. Again, it is more desirable that a condenser should be connected across the supply to the second anode in order to prevent quick changes of scanning amplitude with variations of picture brightness from line to line. In the absence of a condenser, such changes would produce ragged edges on the picture.

The values of the condensers C_1 and C_2 are preferably such that they both give the same time constant with the resistance from which they are fed so that a sudden change of picture brightness causes a proportional rate of change of potential on the first and second anodes. This may be expressed by the equation

$$C_1R_3=\frac{R_1R_2}{R_1+R_2}C_2$$

This time constant is preferably made longer than a frame period a value of 0.05 to 0.1 second being desirable for a frame period of 25 per second.

It will be understood that the condensers C_1 and C_2 also serve to smooth out variations in the H. T. supply and when that source is a rectified alternating current the amount of smoothing required in the rectifier circuit is reduced.

In a circuit arrangement designed for a cathode ray tube which takes approximately equal first and second anode currents and a focussing ratio $k=5$, the following values of resistances and condensers were found to be satisfactory. Resistance R_1 2.8 megohms, resistance R_2 0.7 megohm, resistance R_3 2.8 megohms, condenser C_1 .03 micro-farad and condenser C_2 0.15 micro-farad.

What is claimed is:

1. A supply circuit for a cathode ray tube wherein said tube contains at least two anodes, the second anode being biased to a higher potential than the first anode comprising a source of potential, a variable potentiometer connected in parallel with said source of potential, means for connecting the first anode of the cathode ray tube to the variable arm of the potentiometer, and resistive means R_3 connecting said second anode to the positive terminal of said

potentiometer, said latter resistance having a value substantially equal to

$$\frac{I_1}{I_2}K\frac{(R_1 R_2)}{R_1+R_2}$$

where I_1 is the current through the first anode, I_2 is the current through the second anode, R_1 is the value of the resistance between the positive end of the potentiometer and the point of contact of the variable arm of the potentiometer, R_2 is the resistive value between the point of contact of the variable arm and the negative terminal of the potentiometer, and K is the focussing ratio of the cathode ray tube, said focussing ratio being approximately equal to the value

$$\frac{R_1+R_2}{R_2}$$

2. Apparatus in accordance with claim 1 wherein the three resistive sections are shunted by one condenser, and the resistance R_2 is shunted by a second condenser.

3. Apparatus in accordance with claim 1 wherein the three resistive sections are shunted by a first condenser C_1 and the resistance R_2 is shunted by a second condenser C_2, said condensers being of a value to satisfy the equation that the product of the value of the first condenser and the resistance joining the second anode of the cathode ray tube to the positive terminal of the potentiometer equals the product of the two resistive sections of the potentiometer multiplied by the value of the second condenser and divided by the sum of the values of the two resistive sections of the potentiometer whereby the equation

$$C_1R_3=\frac{R_1R_2C_2}{R_1+R_2}$$

is satisfied.

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