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CONNECTION SYSTEM FOR TELEVISION TUBES

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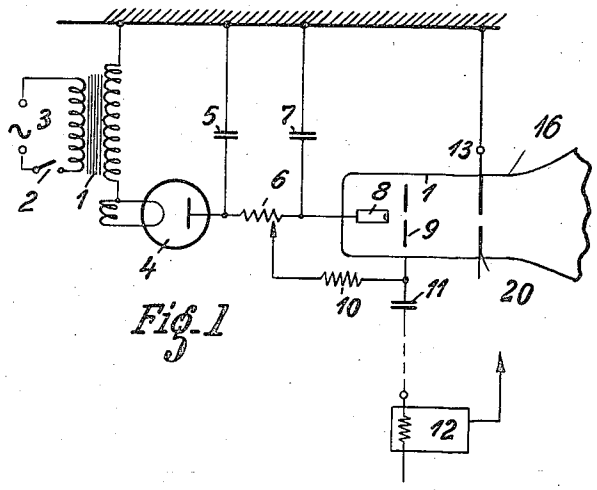


Fig. 1

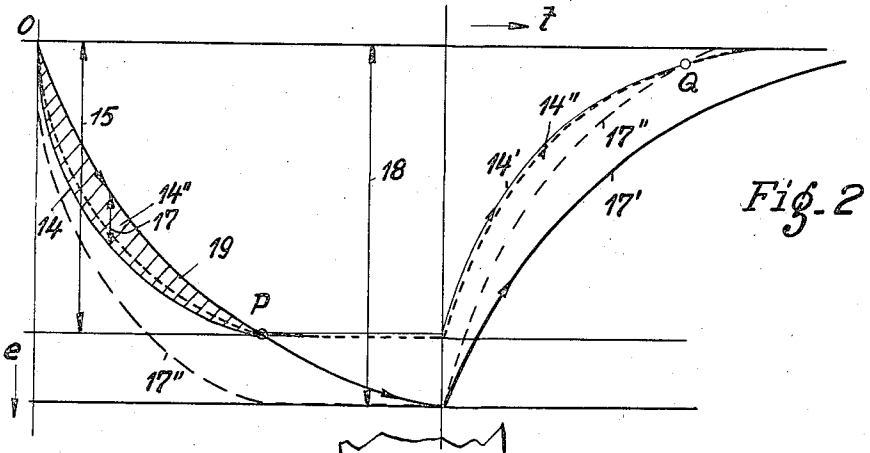


Fig. 2

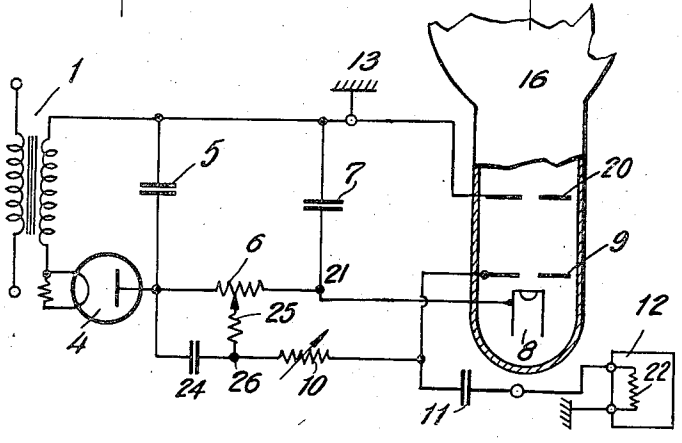


Fig. 3.

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CONNECTION SYSTEM FOR TELEVISION TUBES

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3 Claims. (Cl. 250—27)

Modern television tubes, when operated from an A. C. mains supply, require a very perfect ripple-elimination. The filter chains necessary for this purpose possess, however, very long periods of charge and discharge. In consequence the necessary operating potentials do not occur immediately after switching-on has been initiated, and the output potentials are formed during a relatively long period. These may be very dangerous to the television tube, particularly in the case of the gas-filled type. In accordance with the invention this requirement is combined with the requirement for ripple elimination.

The present invention relates to arrangements which enable a very perfect ripple elimination without any drawback.

The invention will be described in connection with the annexed drawing, in which

Fig. 1 shows for example an arrangement according to the invention,

Fig. 2 shows the course of the connection and disconnection potential curves, while in

Fig. 3 there is illustrated an improved connection according to the present invention.

In Fig. 1 the transformer 1 of the mains-connection apparatus is connected with the mains 3 through the medium of a switch 2, and transforms to an alternating potential of approximately 2000 volts peak value. Half-wave rectification in the tube 4 in conjunction with a condenser 5 provides wholly inadequate ripple elimination. It is necessary, therefore, to provide a further ripple elimination for the cathode potential by a resistance 6 and condenser 7. The cathode 8 of the television tube 16 is directly connected with the condenser 7, whilst the control electrode 9 is connected to the cathode through the medium of a leak resistance 10 with a somewhat more negative point of the connection system, viz, a tapping at the steadying resistance 6, and through the medium of the condenser 11 to the output potential of the television receiver 12. The anode 20 of the television tube 16 is connected with earth 13. This connection system may be regarded as typical for all mains-connection systems for television tubes of this kind. The connections between receiver and deflection means of the tube are not shown.

At switching in the apparatus the negative potential, which proceeds from the rectifier tube 4, is built up more quickly at the cathode 8 than at the control grid 9. The rate at which the cathode is charged is determined by the time constant of the combination of resistance 6 and condenser 7. Charging the control grid, however, requires a longer time, as this grid is connected through the medium of an additional resistance-condenser combination 10, 11 with the receiver 12, and over the low resistance of the latter with earth. The result of this is a course of the connection and disconnection curves as illustrated in Fig. 2. In Fig. 2 ordinates represent the potential difference between the cathode 8 or control grid 9 and the earthed anode 20, and abscissae the time t after the moment of switching in. Both curves will be approximately exponential, but the switching-in curve of the cathode, designated 14, reaches the cathode bias, viz., the potential value 15, earlier than the grid electrode 9, the corresponding curve of which is represented by the line 19. In consequence the relative potential between the grid and the cathode within the shaded zone up to the point of intersection P is positive, the same reaching a value 17 dangerous to the tube and amounting to more than 100 volts shortly after switching in. In this connection break-downs may occur resulting in destruction of the television tube. Also in the case of high-vacuum tubes, since the cathode has not yet become properly heated, there may occur a spot-like heating of the oxide and accordingly damage to the cathode, particularly in the case of frequent repetition of the switching-in operation. It is not until the time abscissa belonging to the point P has been exceeded that the control grid 9 becomes negative in relation to the cathode 8 and finally reaches the correct negative potential value 18.

The processes occurring at the disconnection are illustrated by the curves 14' and 17', and show that in this connection the bias always remains negative, so that the tube is accordingly out of danger.

A satisfactory practical solution to the problem is accordingly obtained if in accordance with the invention the time constant of the control grid circuit is made equal to or preferably less than that of the cathode circuit. There are then obtained the charging and discharging curves 14'' and 17'' shown in broken lines, 14'' being the cathode curves, 17'' the grid curves. These curves show, however, that upon the disconnection the curves might again intersect at the point Q. If the grid possesses a much smaller time constant than the cathode, there again occurs a positive grid bias beyond Q. This, however, is not very dangerous, as all potentials, including the anode potential, have then considerably dropped.

The possibility of performing the inventive idea in simple fashion is revealed by observation of

Fig. 1 from the fact that the resistance and condenser combination 6, 7 requires to be a filter chain for ripple in the mains, and accordingly possesses of necessity a time constant, which is much greater than 50 periods. On the contrary the circuit 11, 10 should allow passage only to frequencies higher than the image-change frequency of 25 periods. The time constant 10, 11 may accordingly be made between $\frac{1}{10}$ and $\frac{1}{100}$ of that of 6, 7, so that the difference in the resulting time constants of the circuits at the control grid 9 and cathode 8 is extremely small. A possible dimensioning in practice is as follows:

Resistance 6=0.3·10⁶ ohms.
Condenser 7=0.3 mf.
Resistance 10=0.3·10⁶ ohms.
Condenser 11=0.011 mf.

The time constant of the latter circuit then amounts to merely approximately $\frac{1}{100}$ of that of the former. The impedance of 11 nevertheless remains even for 25 periods in the same order of magnitude as that of 10, but does not produce any deterioration of the image in view of the phase difference in relation to 10.

Regarding the ripple elimination in the stationary condition of the receiver the control grid 9 is more completely steadied than the cathode 8, as the ripple elimination of 8 is effected only by the condenser 6 and resistance 7, whilst the bias for electrode 9 is additionally steadied by 10/11. If, therefore, complete smoothness against earth is assumed to exist in respect of the control grid 9, an interfering frequency will nevertheless occur in the image (in the form of two black transverse stripes corresponding to 25 periods), as a relative humming potential difference exists between grid 9 and cathode 8.

Accordingly a perfect ripple elimination of the cathode point 8 can be obtained but with difficulty. In the case of control in view of 10 volts grid potential and with the great sensitiveness of the eye to variations in the intensity of the light in the image the relative humming potential between grid and cathode should be smaller than one-tenth of the maximum video potential, i. e., less than 1 volt, preferably not more than 0.1 volt. In order to obtain this it would be necessary to perform the steadying of the cathode potential of say 2000 volts to an extent of approximately 10^{-4}, owing to the fact that the ripple potentials 9 and 10 have the same potential.

When, for improvement of the smoothing, 6 would be increased too much anode potential would be lost and a very expensive high-tension transformer 1 would be required; in the case of increasing, the costs of this high-tension condenser would become too high. With capacities 5, 7 of approximately 0.5 mf., which represent the extreme limit in practice and already require a relatively large amount of space, and with a resistance 6 of 0.3 megohm, it is impossible to obtain a ripple elimination better than 1/20.

According to the invention the effect of the ripple is eliminated by conveying to the grid 9, the ripple of the cathode in exactly the same intensity and phase.

The connection system according to Fig. 1 represents upon closer inspection a bridge connection, the one branch of which consists of 6 and 7 and the other branch of 10 and 11, the cathode 8 being connected with the corner of the first branch and the grid 9 with the corner of the second branch.

By variation of the branches it is possible to impart to a humming potential equal in extent and phase in relation to earth and to obtain an image completely pure.

In the following table there are set forth those pairs of values in respect of 10 and 11, which have resulted by experiment in complete steadying of the image:

(R_g) 11 (10^6 ohms)	(C_g 11 (mf.)
0.05 megohm	0.25 mf.
.5 megohm	.03 mf.
1 megohm	0.015 mf.

These values apply with:

6=0.25 up to .05 megohm 7=0.25 mf.

The arrangement according to the invention obviously has the advantage that steadying means, which are cheap because they are small, may be employed.

The stated arrangement enables the stripes in the image caused by the humming to be completely avoided; there remains however, another defect in the image owing to extensive formation of veils.

This—as the applicant has found—is due to the fact that the time constant 10/11 is too small. With respect to the lower video frequencies it should amount to at least $\frac{1}{10}$ sec., but if possible should be even greater. The time constant of the circuit described, however, amounts to only $\frac{1}{6}$ of this value.

To avoid said defect, the scheme of Fig. 1 is improved according to that of Fig. 3. It differs from that of Fig. 1 by a resistance 25 connecting the tapping point of resistance 6 to the variable resistance 10 and, through condenser 24, to the anode of 4.

The arrangement has the following object: By reason of the bridging condenser 24 it is intended to transmit to the control grid 9 the maximum humming potential occurring in the connection, i. e. at the anode of the rectifier tube 4 in full amount, that is to say,—whilst avoiding the by-path through 6/7. The capacity of 24 should be at least 0.1 mf., better 0.5 mf.; it is subject to A. C. potential only and is accordingly cheap. The resistance 25 should be large as compared with the A. C. resistance of 24 and may amount to 0.3 or 0.5 megohm. The humming potential at the point 26 between 24 and 10 is now as many times greater than before as the direct voltage division at 6, with the stated dimensions about 6 times greater. In order now to compensate this the proportion of the branch 10/11 must accordingly be reduced. This, however, means nothing else than that by increasing 10 or 11 or both together, the time constant of this circuit is to be made six times greater. The practical values are in fact 10=2 megohms, 11=0.033 mf. corresponding with a time constant of approximately 0.06 sec. The resistance 23 serves for facilitating the adjustment of the bridge. This way ripple and veil formation are eliminated simultaneously.

I claim:

1. In a television receiver including an earthed radio receiver, a cathode ray tube having cathode, control grid and earthed anode and a mains supply apparatus comprising a transformer, a single rectifier tube and smoothing means, said smoothing means consisting of a first condenser connecting the anode of said rectifier tube to earth, a resistance connecting the same anode to the cathode of said cathode ray tube and a second

condenser connecting said cathode to earth, said control grid connected by a third condenser to said receiver and by a leak resistance to a slider on said resistance: the discharge time constant of said control grid circuit being at most equal to that of said cathode circuit.

2. In a television receiver including an earthed radio receiver, a cathode ray tube having cathode, control grid and earthed anode and a mains supply apparatus comprising a transformer, a single rectifier tube and smoothing means, said smoothing means consisting of a first condenser connecting the anode of said rectifier tube to earth, a resistance connecting the same anode to the cathode of said cathode ray tube and a second condenser connecting said cathode to earth, said control grid connected by a third condenser to said receiver and by a leak resistance to a slider on said resistance: the discharge time constant of said control grid circuit being at most equal to that of said cathode circuit, means being provided to eliminate the effect of the ripple on the ray of said cathode ray tube by conveying to cathode and control grid of said tube a ripple equal in amplitude and phase.

3. In a television receiver including an earthed radio receiver, a cathode ray tube having cathode, control grid and earthed anode and a mains supply apparatus comprising a transformer, a single rectifier tube and smoothing means, said smoothing means consisting of a first condenser connecting the anode of said rectifier tube to earth, a resistance connecting the same anode to the cathode of said cathode ray tube and a second condenser connecting said cathode to earth, said control grid connected by a third condenser to said receiver and by a leak resistance to a slider on said resistance: the discharge time constant of said control grid circuit being at most equal to that of said cathode circuit, means being provided to eliminate the effect of the ripple on the ray of said cathode ray tube by conveying to cathode and control grid of said tube a ripple equal in amplitude and phase, said means consisting of a resistance connecting said leak resistance to the slider of said first resistance and a condenser connecting the same terminal of said leak resistance to the anode of said valve.

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