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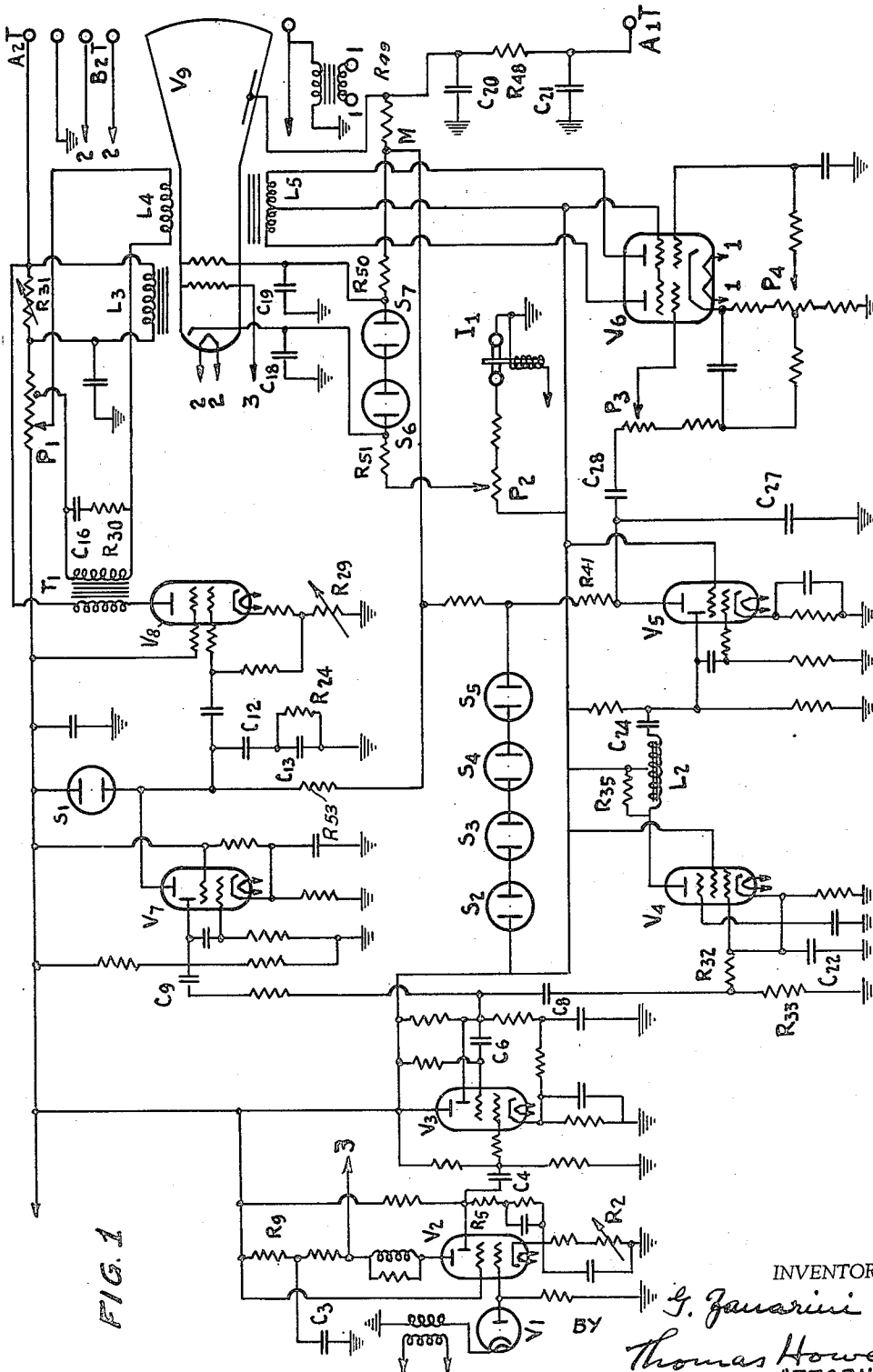
G. ZANARINI

2,369,631

TELEVISION APPARATUS

Filed July 31, 1940

2 Sheets-Sheet 1



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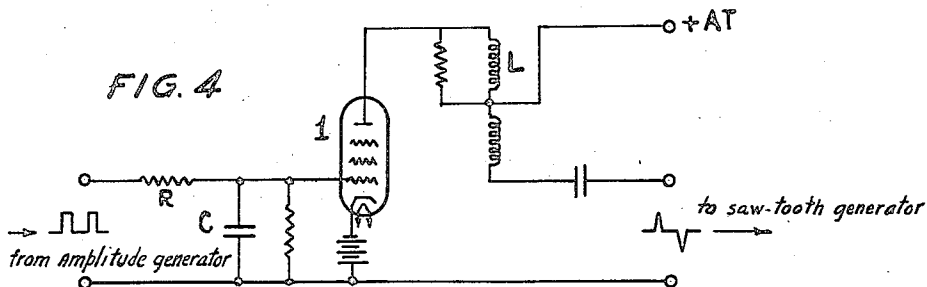
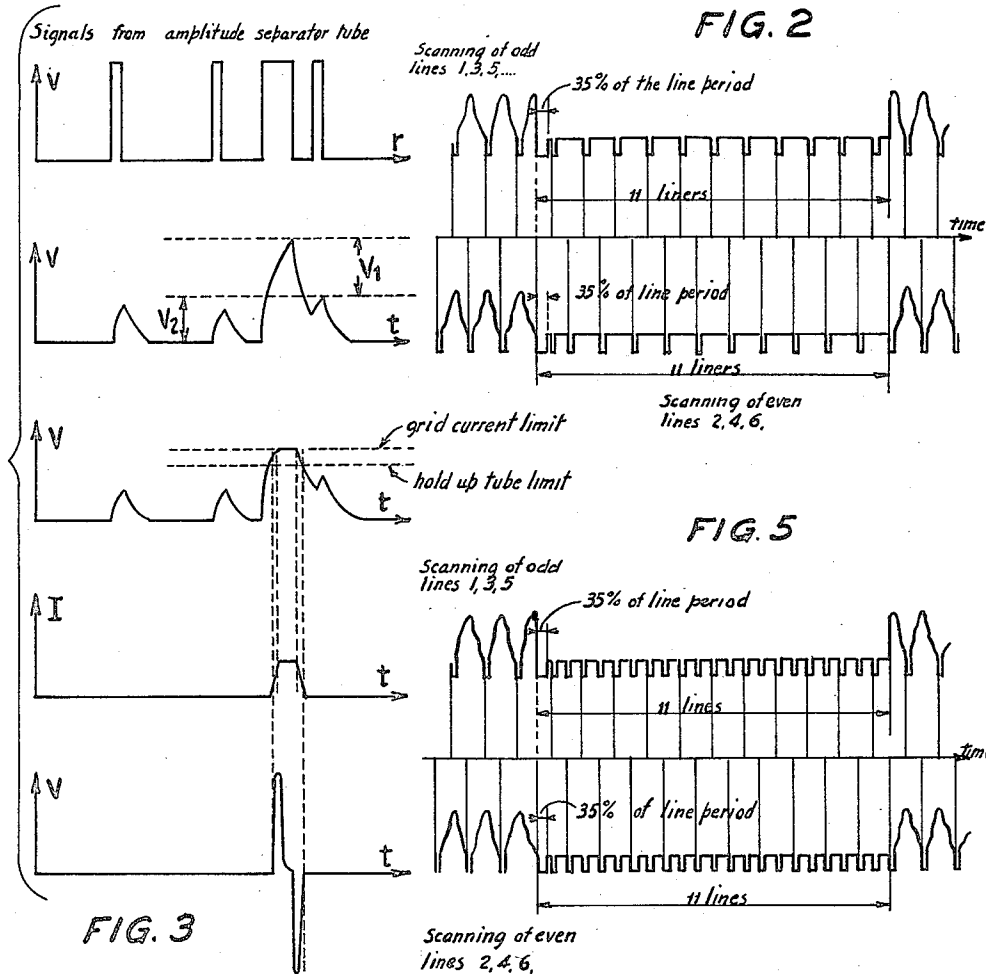
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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TELEVISION APPARATUS

Giuseppe Zanarini, Turin, Italy; vested in the
Alien Property CustodianApplication July 31, 1940, Serial No. 348,656
In Italy May 30, 1940

10 Claims. (Cl. 315-27)

This invention relates to a wireless apparatus, more particularly suited for the reception of television pictures.

The features which distinguish this apparatus chiefly concern the synchronizing circuits, video frequency amplifier and video frequency reproduction circuits; they afford a completely self-adjusting synchronization together with a perfect response of the cathode ray tube to all video frequencies concerned.

The apparatus and the functions of the various circuits shall be described with reference to the accompanying drawings, in which:

Fig. 1 shows the portion of the electric diagram of the apparatus embodying this invention and includes the video frequency amplifier, cathode ray tube and synchronizing devices.

Fig. 2 shows the diagram of the synchronizing signals;

Figure 3 shows the process of separation of the amplitude differentiated signals in the case of the signals of the type shown in Figure 2;

Figure 4 shows the wiring diagram of the hold up tube;

Figure 5 shows a diagram of a synchronizing signal of another type, by which the separator secondary emission tube may be dispensed with.

The envelope of the video and synchronizing signals, after high frequency and intermediate frequency amplification, is detected by diode V_1 and then applied to the control grid of tube V_2 which acts, at the same time, as a video frequency and synchronizing signal amplifier. Tube V_2 is of the secondary emission type, for instance of the Philips EE 50 type and can therefore supply amplified signals of opposite phase, which can then be taken from the anode and secondary cathode, respectively.

The direction of the synchronizing signals was heretofore generally opposite that of the video signals so that phase reversal was necessary in order to actuate the synchronizing devices. This is no longer necessary according to this invention which uses a secondary emission tube, as the tube itself can supply the two desired signals in opposite phase. Supposing by way of example the diagram of the synchronizing signals is that given in Fig. 2, the signals for the actuation of the synchronizing devices are taken from the secondary cathode, as shown in the electric diagram of Fig. 1, while the video signals are taken from the cathode ray tube V_2 , after having undergone a proper correction, the particulars of which will be explained in detail hereinafter. Owing to the

direct coupling existing between the rectifying diode and tube V_2 and between the tube V_2 and cathode ray tube, all shades of the image are properly reproduced.

The signals taken from the secondary cathode of tube V_2 (the amplitude of which depends upon resistor R_3) are applied to the control grid of the amplitude separator tube V_3 through capacity C_4 . The tube V_3 also is of the secondary emission type (for instance EE 50 Philips type) and the main feature of the arrangement consists in a reactive coupling between the secondary cathode and screen grid. By virtue of said coupling the tube always operates (for input signals not below a certain limit, approximately 4-5 volts of the video synchronizing envelope) between a blocked condition existing during the video signals and a saturated condition existing during the interval corresponding to the synchronizing signals. For any value of the input signals amplitude (within certain limits) the amplitude of the separated synchronizing signals supplied by the secondary cathode of the tube V_3 , remains constant and of considerably high value (of the order of 140 volts). Moreover, by virtue of the reactive coupling C_6 existing between the secondary cathode and screen grid, the rectangular form of the synchronizing signals is further improved, while the sensitivity to external static is decreased.

From the secondary cathode of tube V_3 two frequency separator circuits, respectively, are derived for the frame and line signals. Said circuits may be differently arranged according to the type of synchronizing signals. The frame signals are separated by amplitude differentiation obtained by an integration process (circuit formed by elements R_{33} , R_{32} , C_{22}).

The amplitude differentiated signals are then sharply discriminated by tube V_4 which may be a usual pentode. Fig. 3 shows the separation process in the case of signals of the type shown in Fig. 2.

As a consequence of the integrative process, the frame signals, are of a greater magnitude than line signals and this greater magnitude of the frame signals is utilized for obtaining a sharp separation by means of tube V_4 . The cathode of tube V_4 is made sufficiently positive to make the tube inoperative for the line signals; the frame signals only, having a greater magnitude as previously explained, can actuate the tube. Furthermore, the grid current of tube V_4 operates a sharp limitation of the upper part of the frame signals (see diagram Fig. 3), causing the current of the

tube to assume a trapezoidal form characterized by two sharp variations which produce in inductance L_2 two voltage peaks, one of them being used to actuate tube V_5 . The function of resistor R_{35} is to damp out of the oscillations which would follow each voltage peak.

The separation of the vertical synchronizing signals, operated by tube V_4 , is necessary only if the synchronizing signals are of the type indicated in Fig. 2; said separation process does not permit the line signals following the frame signals to affect the duration of the oscillation produced by the oscillator tube V_5 ; in this case, said influence would disturb perfect interlacing, owing to the different position of the frame signal with respect to the line signals which follow it in both cases, viz. when scanning the odd lines and even lines. Tube V_4 , for instance, would no longer be necessary if the diagram of the synchronizing signals were that of Fig. 5.

The vertical synchronizing signals, separated by tube V_4 , synchronize the pulse generator formed by the tube V_5 also of the secondary emission type through C_{24} . The arrangement of the circuit of tube V_5 is characterized by a reactive coupling between the secondary cathode and control grid for the generation of the discharge pulses of capacity C_{27} which therefore generates through the charging resistor R_{41} saw-tooth shaped voltages synchronized with the frame signals as described in my copending U. S. application Ser. No. 340,617 filed June 14, 1940, now Patent No. 2,297,522. The operation of tube V_5 thus mounted is characterized by a great flexibility in performance which owing to the considerable amplitude of the actuating signal enables a perfect and completely automatic synchronization within very wide safety limits to be obtained.

The voltage applied to resistor R_{41} (500 volts approximately) is stabilized by means of small neon bulbs S_2 , S_3 , S_4 , S_5 (the current drawn is approximately 0.5 ma.) in order to avoid vertical fluctuation of the frame, caused by disturbances of a very low frequency reaching the apparatus through the supply circuit.

The saw-tooth signals generated by capacity C_{27} actuate through C_{28} the twin-pentode V_6 operating in push-pull through cathode coupling. The function of the tube V_6 is to generate saw-tooth currents which, flowing through the deflecting coil L_5 generate the vertical magnetic deflection field.

As shown in Fig. 1, the twin-pentode V_6 has a pair of anodes, a pair of control grids and a single cathode, the latter being connected to ground through a cathode resistor and a potentiometer P_4 . The anodes are each connected to one end of the deflecting coil L_5 , the center tap of which is connected to the source of supply A_2T . The saw-tooth signals from the capacity C_{27} are coupled through C_{28} to the potentiometer P_3 and thence pass to ground. Connected to the adjustable tap of the potentiometer P_3 is the left-hand control grid of the twin-pentode V_6 , the right-hand control grid of the twin-pentode V_6 being connected to an adjustable tap on the potentiometer P_4 .

The operation of this portion of the system is as follows:

The capacity C_{27} is gradually charged through the resistor R_{41} and as the voltage across the capacity gradually increases, the voltage applied across the potentiometer P_3 by the capacity C_{27} through the coupling condenser C_{28} also gradu-

ally increases. As the adjustable tap of the potentiometer P_3 is connected to the left-hand grid of the tube V_6 , the output of the left-hand anode circuit of the twin-pentode V_6 also gradually increases causing the magnetic flux in the left-hand portion of the deflecting coil L_5 to slowly increase thereby producing vertical deflection of the electron beam in the cathode ray tube V_5 . However, as the output of the left-hand portion of the tube V_6 increases, there is an increase in the current flow through the cathode resistor and the potentiometer P_4 and, since the right-hand grid of the tube V_6 is connected to the tap on potentiometer P_4 , it is obvious that this grid becomes less positive with respect to the cathode due to the increased voltage drop in the cathode resistor and the potentiometer. The right-hand side of the tube V_6 therefore becomes less conductive than before with two results:

1. As the current flowing in the cathode resistor and the potentiometer P_4 is comprised of the current flow through both anode circuits of the tube V_6 , a reduction in the flow of the right-hand anode circuit when the flow of the left-hand anode circuit is increased, and vice versa, tends to maintain the current in the cathode resistor and the potentiometer P_4 substantially constant since both halves of the tube are caused to operate in push-pull by reason of the cathode coupling between the two grids.

2. The reduction in the flow of the right-hand anode circuit when the flow of the left-hand anode circuit increases causes a reduction in the magnetic field produced by the right-hand portion of the deflecting coil L_5 simultaneously with the increase in the magnetic field produced by the right-hand side of the coil and, as both halves of coil L_5 are connected in opposition, the resultant magnetic field produced by coil L_5 tends to increase linearly instead of increasing logarithmically as does the charge in the capacity C_{27} . Compensation of the logarithmic function of the capacity occurs by reason of the fact that, while the voltage of the left-hand grid of tube V_6 increases logarithmically, the voltage of the right-hand grid tends to decrease logarithmically due to its connection to the cathode resistor and potentiometer P_4 thus producing a compensation which is the mathematical counterpart of the voltage applied to the left-hand grid and thereby eliminating the undesirable logarithmic variation in the magnetic field produced by coil L_5 .

When a frame synchronizing impulse is received on the control grid of tube V_5 , this tube discharges the capacity C_{27} with the result that the above sequence of events repeats itself to produce a continuous vertical scanning of the cathode ray electron beam.

By the push-pull arrangement for the generation of said currents a perfectly linear deflection may be obtained with the aid of very simple means. The potentiometer P_3 makes the adjustment of the amplitude deflection possible and the potentiometer P_4 provides the vertical centering of the frame. Finally, said push-pull arrangement has the advantage of permitting the elimination of the coupling transformer (or impedance) and of drawing practically constant current.

Tube V_6 may be for example of the Philips ELL 1 type.

The line signals taken from the secondary cathode of tube V_3 are separated by derivation by means of capacity C_6 and synchronize the pulse generator formed by the secondary emission tube

V₇ (for instance of the Philips EE 50 type). Apart from the time constants which determine its natural period, said tube operates according to the invention in the same manner as the frame impulse generator formed by the tube V₈ and is featured by the same stability characteristics. Capacity C₁₂ fed by resistor R₃₃ generates a saw-tooth voltage synchronized by the line synchronized by synchronizing signals. The small neon bulb S₁ operates initially only to limit the anode voltage of the tube V₇ while the cathode is still cold. During normal operation the tube S₁ must not be glowing.

The net formed by resistor R₂₄ and capacity C₁₃ gives rise to a desirable distortion of the saw-tooth in order to compensate for the curvature of the mutual characteristic of the tube V₈.

The line saw-tooth signal actuates the tube V₈, a high slope power pentode, for instance of the EL 6 Philips type, which generates the saw-tooth currents necessary for the generation of the horizontal deflection magnetic field.

The circuit of tube V₈ is characterized in that a current negative feedback is provided in order to obtain considerable deflection linearity. The adjustable resistor R₂₉ allows adjustment of the horizontal deflection amplitude by varying the amount of feedback. The horizontal deflection coils L₄ are connected to tube V₈ through a proper transformer T₁. The damping net R₃₀C₁₈ renders the deflecting circuit aperiodic in order to avoid parasitic oscillations.

Horizontal centering of the frame is obtained by supplying the deflecting circuit with a proper amount of D. C. by means of the center-tapped potentiometer P₁.

The coils L₃ provide the magnetic concentration of the cathode beam and focussing of the picture is obtained by adjusting the value of the variable resistor R₃₁. The anode and cathode of the cathode ray tube, according to the invention, are in a special potentiometer circuit including elements R₄₈, R₄₉, R₅₀, R₅₁, P₂ and I₁. The capacities C₂₀, C₂₁ and C₁₉ have a smoothing action.

Said potentiometer circuit is featured by the presence of a point M in which the voltage with respect to ground is independent of the current consumption of the cathode ray tube. Said voltage may be chosen within certain limits by properly designing the potentiometer elements and, according to the invention, the same voltage is used to feed the discharge devices which generate the saw-tooth line and frame signals needed for driving tubes V₈ and V₆, respectively.

As will be seen in Fig. 1, the anode of the cathode ray tube V₉ is connected to a point between the resistors R₄₈ and R₄₉, of the potentiometer circuit, which is energized from the high voltage source A₁T. The cathode of tube V₉ is connected to a point on the potentiometer circuit between the resistor R₅₁ and neon tube S₈, the function of which will be described hereinafter. It is obvious, therefore, that the cathode-anode circuit of the cathode ray tube V₉ is connected in parallel with the neon tubes S₆, S₇ and the resistors R₅₀ and R₄₉ and that any variation in the current consumption of the cathode ray tube due to the variations in the signal placed on its control grid will cause variations in the voltage drop across elements S₆, S₇, R₅₀ and R₄₉. However, if the resistances of the resistors R₄₈, R₄₉ and R₅₁ are made equal, and the resistance of the neon tubes S₆ and S₇ added to that of the resistor R₅₀ is made equal to the resistance of each of resistors R₄₈, R₄₉ and R₅₁, a point such as M will

be found in the portion of the potentiometer comprised of elements S₆, S₇, R₅₀ and R₄₉ which is electrically in the center thereof and in which no voltage variation with respect to ground takes place regardless of the variations in the voltage across said portion of the potentiometer when the load on the cathode ray tube varies. In these respects, the potentiometer is structurally similar to and acts like a bridge. The point M, because it holds a constant voltage is connected to charge the frame capacity C₂₇ through the resistor R₄₁ and the line capacity C₁₂ through the resistor R₃₃ to thereby produce uniform saw-tooth deflecting voltages for the scanning operation of the cathode ray beam.

The voltage of the point M may be chosen of a considerably high value (for instance, 1000 volt with A₁T=5000 volt) in order to obtain saw-tooth voltages of a very linear form and of considerable amplitude (as required, for instance, for the actuation of tube V₈ owing to the feedback arrangement of the same). The resistor R₅₁ which is an element of the potentiometer circuit, is properly designed in order to safeguard the cathode ray tube, should the A₂T voltage (about 300 volt) accidentally fail.

In such case, the control grid of tube V₉ would fall to ground potential, while the cathode of the tube would assume with respect to ground the voltage appearing across R₅₁, said voltage being chosen of a value sufficient to cause blocking of the tube. The current of the electronic beam of tube V₉ flowing in resistor R₅₁ produces a negative feedback effect, its value depending upon the frequency in relation with capacity C₁₈.

The lower the frequency, the greater the negative feedback will be and, according to the invention, it is totally compensated for by means of the net R₆C₃ placed in the anode circuit of the video frequency amplifier tube V₂. The effect of the net R₆C₃ consists in an increase in the amplification of the lower frequencies and is such as to exactly compensate for the negative feedback just described.

The cause of the negative feedback will readily become apparent from a study of Fig. 1. The cathode of the cathode ray tube V₉ is connected to ground through resistor R₅₁, potentiometer P₂ and the thermic delayed relay I₁. As the control grid circuit of the cathode ray tube is connected to ground through the amplifier V₂, the cathode current of the cathode ray tube, as it flows through resistor R₅₁, will cause the grounded end of resistor R₅₁ to become more negative and thus place a negative bias on the grid of the cathode ray tube. This bias will vary in proportion to the feedback current through the resistor R₅₁ which is in turn responsive to the frequency of the video signals applied to the cathode ray tube V₉. Because of the presence of capacity C₁₈, a low-frequency will cause more feedback than a high frequency and this variation produces an error in the video reception which requires compensation by means of the network R₆C₃ in the manner pointed out hereinabove.

The two small neon bulbs S₆ and S₇ stabilize the potential difference existing between the screen grid and cathode of the cathode ray tube V₉. Said stabilization is very useful, considering that the screen grid current of the cathode ray tube of the same type may assume widely different values. Potentiometer P₂ allows adjustment of the average bias of the cathode ray tube and consequently varies the medium shade of the picture. The thermic delayed relay I₁ avoids the

formation of the luminous spot on the fluorescent screen at the time when the set is switched on and the cathodes of the tubes are still cold.

The external controls of the assembly just described are reduced to a single control P_2 for the adjustment of the medium shade. All other semi-fixed elements (R_2 , R_{2s} , R_{31} , P_1 , P_3 , P_4) are inside the apparatus and are adjusted during the lining up of the set.

No control is provided for the adjustment of synchronization, as this is completely self-adjusting. Practically, it was found unnecessary to provide the set with controls of that kind owing to the wide safety limits of the synchronizing circuit.

What I claim is:

1. In a television apparatus a push-pull circuit for magnetic deflexion of cathode rays comprising in combination with a cathode ray tube a twin-pentode having a cathode coupling consisting of a single set of cathode resistors, deflecting coils directly connected to the anodes of said twin-pentode operating in push-pull by means of said cathode coupling and means for applying a saw-tooth actuating voltage to one only of the control grids of said twin-pentode.

2. In a television apparatus, a push-pull circuit for magnetic deflexion of cathode rays, comprising in combination with a cathode ray tube, a twin pentode having a cathode coupling consisting of a single set of cathode resistors, deflecting coils directly connected to the anodes of said twin pentode operating in push-pull by means of said cathode coupling, means for applying an actuating saw-tooth voltage to one only of the control grids of said twin pentode and means for applying a constant voltage with respect to the cathode to one of the control grids of said twin pentode.

3. In a television apparatus, a push-pull circuit for magnetic deflexion of cathode rays, comprising in combination with a cathode ray tube, a twin pentode having a cathode coupling consisting of a single set of cathode resistors, deflecting coils directly connected to the anodes of said twin pentode operating in push-pull by means of said cathode coupling, means for applying an actuating saw-tooth voltage to one only of the control grids of said twin pentode, means for applying a constant voltage with respect to the cathode to the other control grid of said twin pentode and means for adjusting the base bias of one of said control grids of said twin pentode.

4. In a television apparatus, a push-pull circuit for magnetic deflexion of cathode rays, comprising in combination with a cathode ray tube, a twin-pentode having a cathode coupling consisting of a single set of cathode resistors, deflecting coils directly connected to the anodes of said twin pentode operating in push-pull by means of said cathode coupling, means for applying an actuating saw-tooth voltage to one only of the control grids of said twin pentode, means for applying a constant voltage with respect to the cathode to the other grid of said twin pentode and means for adjusting the voltage of one of the grids of said twin pentode.

5. In a television apparatus, a cathode ray tube having a control grid, a cathode, an anode, and deflecting coils, a video-frequency amplifier, a source of power supply, a potentiometer connected to said source of power supply, connections from said cathode, and anode to two separate points, respectively, intermediate the ends of said potentiometer, control means for said deflecting coils connected to the potentiometer intermediate said two points and at the electrical center therebetween, a connection from the output of said video-frequency amplifier to said control grid, and means responsive to the output of said video-frequency amplifier for compensating for negative feedback between said cathode and the control grid.

6. In a television apparatus, in combination with a cathode ray tube having a control grid and cathode and anode electrodes, a source of power supply, a video-frequency amplifier having an anode circuit, a potentiometer comprising a plurality of resistors in series energized by said source of supply, cathode and anode circuits comprising connections from said electrodes to separate points on said potentiometer spaced from the ends thereof, a correcting circuit for compensating the negative feedback effect produced by the potential drop of the cathode circuit current through one of said resistors, and a grid circuit comprising a connection from said video-frequency amplifier anode circuit to said control grid which includes said correcting circuit.

7. Television apparatus, as claimed in claim 6, comprising an impedance placed in series in the anode circuit of the amplifier stage of the video-frequencies in turn directly connected with the grid circuit of said cathode ray tube, said impedance compensating for the negative feedback effect produced by the impedance of the cathode circuit of said cathode ray tube.

8. Television apparatus, as claimed in claim 6, comprising a cathode impedance of the cathode ray tube consisting of said one of said resistors and a capacitive element in parallel with each other and a compensating impedance consisting of a resistor element and a capacitive element in parallel with each other and connected in series with the anode circuit of the video-frequency amplifier stage in turn directly connected with the grid circuit of said cathode ray tube, said impedance having the same time constant.

9. Television apparatus, as claimed in claim 6, comprising a second potentiometer, a source of direct current connected across said second potentiometer, an adjustable slider on said second potentiometer connected to one end of the first potentiometer whereby a bias voltage is provided in series with said source of power supply for adjusting the voltage applied across said cathode and anode electrodes.

10. Television apparatus, as claimed in claim 6, comprising a screen grid in said cathode ray tube, and means included in said potentiometer for stabilizing the voltage of a portion thereof, said cathode electrode and said screen grid being connected across said portion of the potentiometer.

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