Jan. 5, 1943. J. HARDWICK 2,307,218

THERMIONIC VALVE CIRCUIT

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Fig. 1

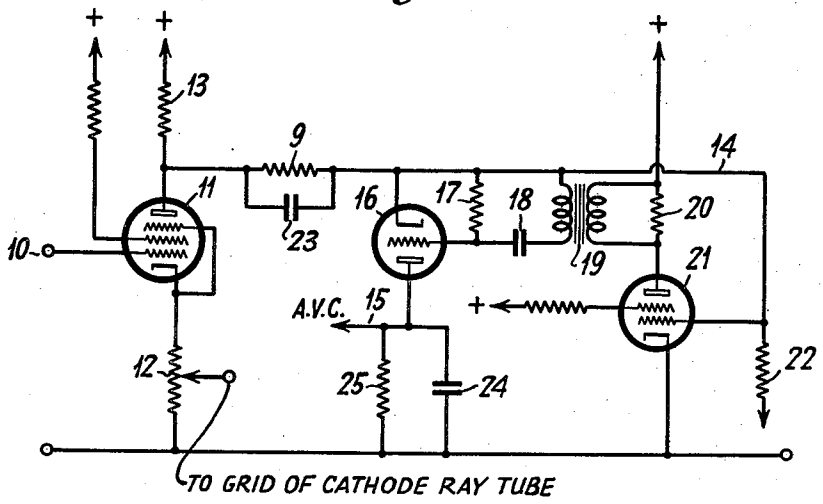
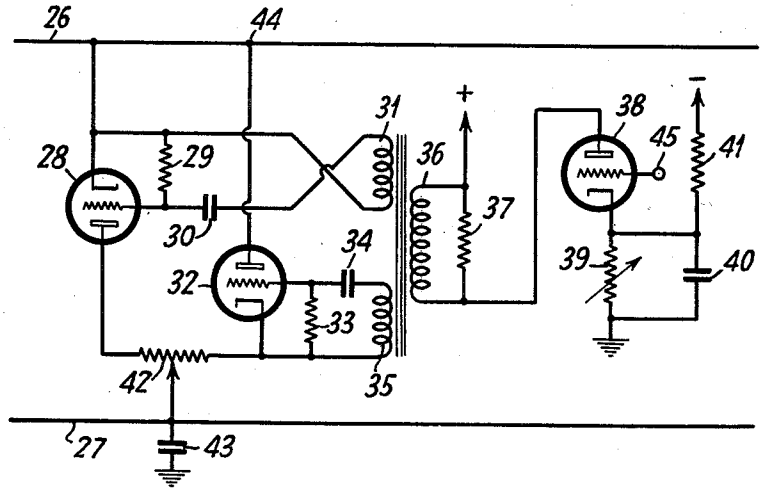


Fig. 2



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THERMIONIC VALVE CIRCUIT

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4 Claims. (Cl. 178—7.1)

The present invention relates to thermionic valve circuits and more particularly to thermionic valve switching circuits.

In a number of cases it is desirable to switch an observing device into a circuit in order to observe the conditions of the circuit at a given instant; for example, in the application of automatic volume control to television circuits it has been suggested that a corrective signal for controlling the gain of television amplifiers can be obtained by observing the amplitude of recurrent datum portions of the television signal, such as the peaks of the synchronising signals, or levels inserted in the television wave form corresponding to, say, black level. In the specification of U. S. application Serial No. 69,831 for instance there is disclosed, inter alia, means for deriving correcting signals for automatic volume control, or for D. C. re-insertion, in which a waveform is employed comprising switching pulses, which may be synchronising pulses, followed shortly by datum portions corresponding to black level which are succeeded by picture signals. Various methods are described therein for arranging that the synchronising pulses switch in an observing device, so that it observes only the datum portions of the signal wave-form. The methods described are rather complicated and involve the use of multivibrators and delay networks for carrying out the switching operation.

It is the object of the present invention to provide an improved switching device.

According to the invention an electrical switch is provided for connecting a point on a line transmitting electrical signals to another point, such as to an observing device, said switch comprising a thermionic valve having at least three electrodes, and which is so operated as to function as a switch by the application of switching pulses thereto, said switching pulses being derived from controlling pulses by passing said controlling pulses through coupling means which is so constituted and arranged that the switch is only rendered conductive after the termination of the controlling pulses.

In the preferred form of the invention the controlling pulses are preferably of flat topped form with sharp edges, and the coupling consists of a transformer with its primary inductance so chosen that each controlling pulse is differentiated to give effectively two pulses, of opposite sign, generated by the leading and trailing edges respectively of the controlling pulse. The pulse generated by the trailing edge is the one employed as a switching pulse and the connections of the transformer winding are arranged to give this pulse a positive sign.

The invention may be used for the purpose referred to in the specification of U. S. application Serial No. 69,831 in which the television signals have synchronising pulses followed by datum periods, and it is desired to switch an observing device into the operative condition during the datum periods. If desired, however, separately generated pulses may be applied to the coupling.

According to a feature of the invention the switch may comprise two such thermionic valves connected back-to-back to form a two way conducting switch.

In order that the said invention may be clearly understood and readily carried into effect it will now be more fully described with reference to the accompanying drawing in which Figures 1 and 2 illustrate particular embodiments according to the invention.

Referring to Figure 1, which illustrates the use of a switch according to the invention as applied to a television receiver for automatic volume control, the valve 11, which is a cathode follower valve, has a large cathode impedance 12 and a suitable anode resistance 13. The valve 11 has applied to its terminal 10 rectified television signals, the picture signals being in the positive sense. A suitable type of television signal for use with this circuit is that known as the Marconi-EMI transmission, an example of the waveform of which is illustrated in the Wireless World dated October 4, 1935, page 373. Picture signals derived from a tapping on the impedance 12 are taken to a suitable picture reproducer, for example, a cathode ray tube. For the purpose of providing correcting signals for automatic volume control, a condenser 24 and resistance 25 are connected between the earth line and lead 15 which conveys the automatic volume control correcting signals to the radio frequency amplifier stages. It is arranged that the condenser 24 is charged only during the portions of the television waveforms which correspond to the black datum portions. This is carried out by means of the switch according to the invention which comprises valve 16 in conjunction with a suitable coupling, preferably a transformer 19; the cathode of the valve 16 being joined to line 14 and the anode of the valve 16 being connected to the line 15. Valve 16 is provided with grid leak 17 and grid condenser 18 and the grid circuit is supplied with differentiated synchronising pulses from the transformer 19. The primary winding of transformer 19 is connected in the anode circuit of the screen grid valve 21, the cathode of which is connected to earth and the anode circuit of which is connected to a suitable source of positive potential (not shown). The control grid of valve 21 is connected by means of line 14, resistance 9 and coupling condenser 23 to the anode of valve 11, according to the method described in the specification of U. S. Patent No. 2,120,823 suitable grid resistance 22 being provided for valve 21 and biassed so that the valve acts as an am-

plitude separator. The inductance of the primary winding of the transformer 19 is arranged to be low in value so that the synchronising pulses which are produced in the anode circuit of valve 21 cause partially differentiated pulses to be applied to the grid of valve 16. For example, at the beginning of a controlling pulse, a sharp negative pulse is applied to the grid of valve 16, while at the trailing edge of the controlling pulse due to the differentiation a positive pulse is applied to the grid. It is preferable to connect a suitable resistance 20 in shunt with the primary of the transformer.

The circuit operates as follows. The television signals are applied with the picture signals in the positive sense to the grid of valve 11 and are inverted in the anode circuit of this valve and applied to the grid of valve 21 with the synchronising pulses in the positive sense. If the amplitudes of the synchronising pulses are sufficient valve 21 is biassed back and rendered non-conducting during the picture periods due to the grid current flowing during the synchronising pulse periods. Thus, pulses of current corresponding only to synchronising pulses are produced in the anode circuit of valve 21 and differentiated synchronising pulses are applied to the grid of valve 16. For example, suppose the pulse of current flowing through valve 21 is of a square waveform then the potential across the secondary winding of transformer 19 is such that the trailing edge of the square waveform produces a short pulse in the opposite sense to the pulse produced by the leading edge. By means of the grid condenser 18 and grid leak 17, and by choosing the transformer connections such that the pulse produced by the trailing edge is positive in sign, it is arranged that the valve 16 only conducts when this pulse is applied to its control grid. It will be seen that the valve 16 only conducts during a period shortly after the synchronising pulse has ceased to be applied to valve 21. The valve 21 may function as the picture signal and synchronising signal separator of the receiver. Since the black level portion of the Marconi-EMI television waveform coincides with this period, the line 14 is connected to the condenser 24 only during those periods when line 14 conducts the datum portions. In order that the very high frequencies shall not be attenuated it is desirable that the capacity of the transformer to earth shall be small.

In the television waveform used as an example, the synchronising pulses have a duration of 10 micro-seconds and these are followed by black datum portions of 4 micro-seconds duration. A suitable time constant for the differentiating circuit is 5 micro-seconds and the value of the resistance 20 is chosen in conjunction with the primary inductance of transformer 19 in order to satisfy this requirement. By arranging the amplitude of this differentiating pulse in conjunction with the grid base of valve 16 it is possible to arrange that the valve 16 only conducts during the 4 micro-seconds black datum portion.

If the signal, which it is assumed contains the D. C. component, applied to terminal 10 should vary in intensity through variations in transmission conditions, the black datum level of line 14 will vary. For example, should the signals applied to terminal 10 decrease in amplitude the black datum level on line 14 tends to increase and this makes the condenser 24 charge positively and thus produces a counteracting bias for the radio frequency amplifying valves. The leak resistance 25 is provided for the purpose of slowly discharging condenser 24 so that should the datum level on line 14 decrease in value the valve 16 will be able to conduct. The time constant formed by the condenser 24 and resistance 25 is chosen so that the level of the picture signals do not change sufficiently during the line periods to be noticeable. In this respect it can be shown that the effective time constant of the circuit is the R. C. time constant divided by the gain of the amplifiers in the automatic volume control loop circuit.

The use of the leak resistance 25 introduces a source of error into the automatic volume control in that the discharging of the condenser 24 superimposes a sawtooth shaped potential on the automatic volume control bias during the picture periods. In order to avoid this difficulty it is preferable that a two-way conducting switch be employed instead of the one-way conducting switch of Figure 1.

A modification of the invention employing a two-way conducting switch is illustrated in Figure 2. In this figure it is assumed that the line 26, which is preferably fed from a low impedance source, conveys electrical signals which it is desired to observe. The condenser 43, which is connected between line 27 and earth, is in this case the observing device and may be used for purposes of automatic volume control, D. C. reinsertion and such like. The two-way conducting electrical switch is arranged to connect line 26 to line 27 at a given instant. The switch comprises two thermionic valves, 28 and 32, which are provided with suitable grid leak resistances 29 and 33 respectively and grid condensers 30 and 34 respectively. The control grids of both valves 28 and 32 are supplied with differentiated pulses by means of the secondary windings 31 and 35 respectively of a transformer which has a primary winding 36. The cathode of valve 28 is connected to line 26 and the anode of valve 28 is connected through a resistance potentiometer 42 to the cathode of valve 32. The tapping of potentiometer 42 is connected to line 27 and the anode of valve 32 is connected at 44 to line 26. In this case suitable controlling pulses are applied to terminal 45 connected to the grid of valve 38 which acts as an anode bend separating valve and is suitably biassed by means of a potentiometer 41, 39 with de-coupling condenser 40. The primary winding 36 of the transformer is connected in the anode circuit of the valve 38 and is supplied with a suitable positive potential. A resistance 37 is connected in shunt with the primary winding 36 of the transformer. The switch operates in a similar manner to the single valve switch of Figure 1, in other words, pulses are applied to terminal 45 which produce differentiated pulses across the secondary windings 31 and 35 of the transformer. The pulses derived from the trailing edge are applied in a positive sense, to the grids of the valves 28 and 32 with such an amplitude that these valves only conduct for a short time after the synchronising pulses have ceased to be applied to terminal 45. It is thus possible for the observing device 43 to be charged to the potential of line 26 during those periods immediately following the application of pulses to the switching device. The purpose of the potentiometer 42 is to balance the two valves and it is found that this is of advantage when the line 26 is subject to interfering pulses. It will be appreciated that the two-way conducting switch

shown in Figure 2 permits current to flow from line 26 to line 27 or vice versa. This distinguishes from the one-way switch shown in Figure 1 in which current can only flow through the switch from line 14 to line 15.

It is known that in television transmitting circuits D. C. re-insertion and AVC are sometimes necessary and the present invention may equally be applied to transmitters as well as to receivers.

I claim:

1. A television system wherein a control voltage is developed in accordance with the intensity of the signals received during the synchronizing interval and wherein picture and synchronizing signals are alternately received as a combined single signal series comprising a first discharge tube having a cathode, a control electrode and an anode, means including an impedance for maintaining the anode positive with respect to the cathode, means for applying picture and synchronizing signals to the control electrode of said tube with the synchronizing signals extending in a negative direction, means including a second electron discharge tube for separating the synchronizing signals from the picture signals, means for differentiating the separated synchronizing signals in order to produce a short negative impulse and a short positive impulse for each synchronizing signal, a condenser, means for connecting one terminal of the condenser to a point of fixed potential, an electronic discharge path, and means including said electron discharge path and a series resistance for effectively connecting the other terminal of the condenser to the anode of said first discharge tube only during the interval when short impulses of a predetermined polarity are produced to maintain a charge on the condenser which is a function of the intensity of the signals received during that interval.

2. A television system wherein picture signals and synchronizing signals are alternately received as a combined single signal series and wherein a control voltage is developed in accordance with the intensity of the signals received between successive picture signal intervals comprising a first discharge tube having a cathode, a control electrode and an anode, means including an impedance for maintaining the anode positive with respect to the cathode and with respect to a point of fixed potential, means for applying the received picture signals and synchronizing signals to the control electrode of said tube with the picture signals extending in a positive direction and with the synchronizing signals extending in a negative direction, means including a second electron discharge tube for separating the synchronizing signals from the picture signals, means for differentiating the separated synchronizing signals in order to produce a short negative impulse and a short positive impulse for each synchronizing signal, a condenser, means for connecting one terminal of the condenser to the point of fixed potential, and means including an electronic switching device responsive to the produced short impulses of a predetermined polarity for effectively connecting the other terminal of the condenser to the anode of said first discharge tube only during the final portion of the intervals between successive picture signals to maintain a charge on the condenser which is a function of the intensity of the signals received during those intervals.

3. A television system wherein picture and synchronizing signals are received as a combined single signal series and wherein a control voltage is developed in accordance with the intensity of the received signals during the synchronizing signal intervals comprising a first discharge tube having a cathode, a control electrode and an anode, means including a resistance for maintaining the anode positive with respect to the cathode and with respect to a point of fixed potential, means for applying picture and synchronizing signals to the control electrode of said first discharge tube with the synchronizing signals extending in a negative direction whereby amplified picture and synchronizing signals will appear at the anode of said first discharge tube with the synchronizing signals extending in a positive direction, means including a second electron discharge tube for separating the synchronizing signals from the picture signals, means for differentiating the separated synchronizing signals in order to produce a short negative impulse corresponding to the front edge of each synchronizing signal and a short positive impulse corresponding to the trailing edge of each synchronizing signal, a condenser means for connecting one terminal of the condenser to the point of fixed potential, and an electronic switching device responsive to the produced short positive impulses only for effectively connecting the other terminal of the condenser to the anode of said first discharge tube whereby a charged condition may be maintained on said condenser, which is a function of the intensity of the signals received during the signal intervals.

4. A television system wherein picture and synchronizing signals are received as a combined single signal series and wherein a control voltage is developed in accordance with the intensity of the received signals during a portion of the interval of and immediately following the receipt of the synchronizing signals comprising a first discharge tube having a cathode, a control electrode and an anode, means including a resistance for maintaining the anode positive with respect to the cathode and with respect to a point of fixed potential, means for applying picture and synchronizing signals to the control electrode of said first discharge tube, a second discharge tube for separating the synchronizing signals from the picture signals, a differentiating circuit for producing short negative impulses corresponding to the front edge of each synchronizing signal and for producing a short positive impulse corresponding to the trailing edge of each synchronizing signal, a condenser, means for connecting one terminal of the condenser to the point of fixed potential, and an electron switching device responsive to the short positive impulses only for effectively connecting the other terminal of said condenser to the anode of said first discharge tube during the application of the short positive impulses to said switching device whereby a charged condition may be maintained on said condenser which is a function of the strength of the received signals during a portion of the synchronizing signal interval and the time immediately following that interval.

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