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ELECTRICAL APPARATUS

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FIG. 1.

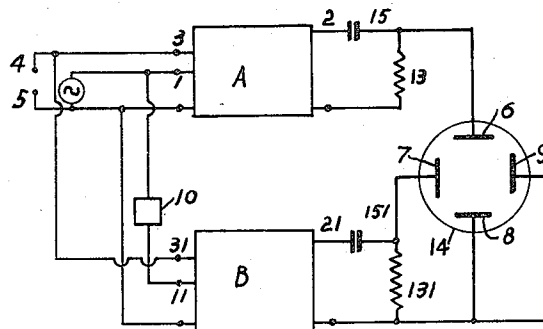
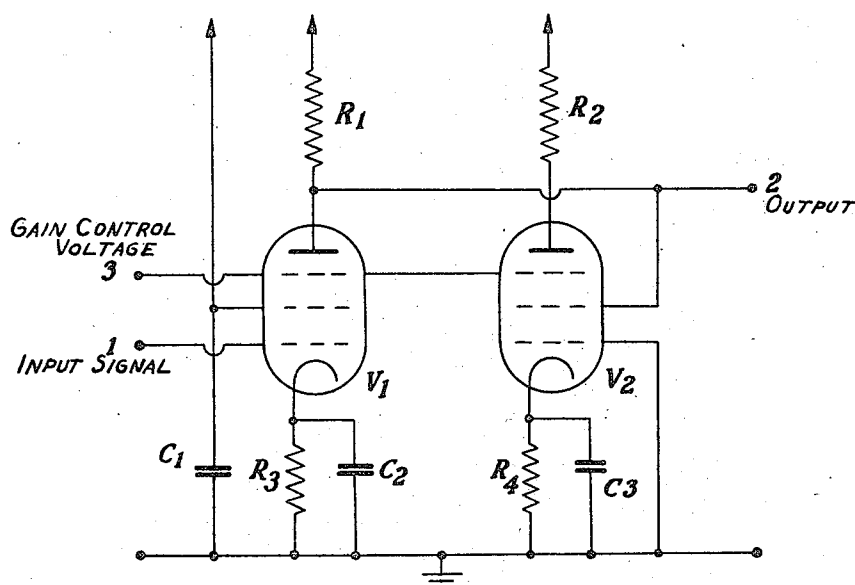


FIG. 2.

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ELECTRICAL APPARATUS

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8 Claims. (Cl. 315-24)

This invention relates to thermionic valve circuits.

A circuit according to the invention comprises a combination of two valves of the pentode type, the suppressors of which are coupled together, the screen of the first valve and the control grid of the second valve being maintained at zero signal potential, the input being applied to the control grid of the first valve, and the screen of the second valve being coupled to the anode of the first valve to provide the output, the whole arrangement being such that the anode currents of both valves are cut off when desired by a reduction of the potentials of the suppressors, and the resulting increase of screen current of the second valve is substituted for the anode current of the first valve.

In the accompanying drawing, Fig. 1 illustrates the use of the invention in a radio frequency amplifier stage, and Fig. 2 illustrates its application to the production of a polar diagram on the screen of a cathode ray tube. Fig. 1 shows a circuit diagram of a radio frequency amplifier stage in which the input signal is applied between earth and the terminal 1, which is connected to the control grid of a pentode amplifier valve V_1 .

The screen of pentode V_1 is maintained at constant potential equal to the mean anode potential, being connected to a high tension source and also being connected through condenser C_1 to earth.

A second pentode valve V_2 , having identical characteristics with valve V_1 , has its screen directly connected to the anode of valve V_1 . Its control grid is directly connected to earth.

Valves V_1 , V_2 are provided with equal anode load resistors R_1 , R_2 and equal self-biasing resistors R_3 , R_4 and by-pass condensers C_2 , C_3 respectively.

The suppressors of valves V_1 , V_2 are directly connected together. It may be necessary to insert a small resistance, the value of which may be of the order of 100 ohms, in the connection between the suppressors to prevent parasitic oscillations.

During the transmission of signals, the potentials of the suppressors are maintained constant, for example, at cathode potential. The screen current of valve V_2 , therefore, remains constant, and in flowing through resistor R_1 does not disturb the alternating component of the output voltage which is developed across resistor R_1 and obtained between terminal 2 and earth.

When it is desired to quash abruptly, either wholly or partly, the amplifier gain, the potentials

of the suppressors are reduced abruptly by the application of a negative potential to terminal 3.

A change of potential of the suppressor of a pentode valve does not appreciably affect the cathode current; it merely changes the proportion in which the cathode current is divided between anode and screen. The decrease of anode current, therefore, appears as an increase of screen current.

The two valves V_1 , V_2 are under substantially identical mean operating conditions and they have substantially identical characteristics. The increase of screen current of valve V_2 for a given reduction of potential of the suppressors is, therefore, equal to the corresponding decrease of mean anode current of valve V_1 . It follows that the abrupt reduction of the potentials of the suppressors does not lead to any change in the direct component of current in anode load R_1 . Further, the absence of elaborate circuits between the valves results in the avoidance of time delay between the decrease of anode current of valve V_1 and the increase of screen current of valve V_2 . Quashing of the gain of the amplifier is therefore effected without producing spurious oscillations of the kind known as "ringing."

The invention may be applied to a television transmitter video amplifier, for the purpose of substituting for the picture signal a signal of steady value. This may, for example, be a signal representing full black, which is inserted at the end of the scanning of each line of the picture. The steady value required will not normally be equal to the mean value of the picture signal. The increase of screen current on valve V_2 for a given change of potential of the suppressors will, therefore, be required to be somewhat different from the decrease of anode current on valve V_1 . The characteristics or the mean operating conditions of the two pentode valves must, therefore, be somewhat different. The necessary adjustment may be made, for example, by adjusting the control grid bias of valve V_2 , and for this purpose resistor R_4 may be made adjustable.

A further feature of the invention is its application to the production of a polar diagram on the screen of a cathode ray tube, the tube being of the type arranged for asymmetric deflection in two mutually perpendicular directions. The tube should preferably have equal deflection sensitivity for the two directions of deflection.

Two pairs of pentode valves are employed, each pair being connected in a circuit such as that shown in Fig. 1.

In order to produce rotation of the beam at

constant angular velocity, sine wave potentials in quadrature are applied to the control grids of the first valves of each pair. The output of one pair is applied to the deflection system for one direction of deflection, and the output of the other pair to the other deflection system.

The operating conditions of the valves are adjusted so that the trace on the cathode ray tube screen is circular.

Radial deflection of the spot is obtained by variation of the potentials of the suppressors of both pairs of valves simultaneously.

A circuit of the above type is shown in Fig. 2. A and B represent two circuits each of which corresponds with the circuit shown in Fig. 1. The input terminals 1 and 3 and output terminal 2 of circuit A correspond to the like-numbered parts of Fig. 1, and the corresponding terminals of circuit B are numbered 11, 31 and 21 respectively. A sine-wave alternating source 12 is connected between the terminal 1 and the earth terminal of circuit A, and also through a quadrature phase shifting device 10 to the corresponding input terminal 11 and earth terminal of circuit B. The potential variation for the control electrodes or suppressors is applied between the terminals 4, 5, terminal 4 being connected to the input terminals 3 and 31 and terminal 5 to the earth connections of circuits A and B.

A suitable cathode ray tube is arranged for asymmetrical deflection, deflector plates 8 and 9 being connected to earth. The opposite plates 6 and 7 are coupled to the output terminals 2 and 21 of circuits A and B respectively through coupling condensers 15 and 151. The grid leaks 13 and 131 are provided to maintain the mean potentials of plates 6 and 7 at the potentials of plates 8 and 9.

Various other types of valves besides pentodes have also the quality that the variation of potential of one of the electrodes is effective merely to decrease the current flowing to one electrode and to increase the current flowing to another electrode. The term "valve of the pentode type" in this specification is intended to cover all other valves which share this quality. When used in context with this term, the terms "suppressor," "screen" and "anode" are intended merely to indicate the electrodes in respect of which this quality obtains, independently of the question whether they have also the other functions associated with such electrodes in the ordinary pentode.

A hexode, for example, is a valve of the pentode type. In the hexode, variation of the potential of the third grid effects the transfer of output current between (1) the anode, and (2) the 2nd and 4th grids which are connected together. In the hexode, the third grid is to be regarded as the "suppressor" although it does not suppress the passage of secondary electrons between the screen, which here consists of the 2nd and 4th grids, and the anode.

In a preferred arrangement according to the invention, the two valves of the pentode type are enclosed in a single envelope and have a common cathode.

In some applications of the invention, it may be desired to avoid direct current connection of the suppressors of the two pentode valves, and/or of the anode of the first and the screen of the second. Alternating current couplings, such as resistance-condenser couplings, may be substituted, provided that their time constants are

suitably selected for the purpose for which the circuit is required.

We claim:

1. A thermionic valve circuit comprising in combination two valves each having at least a cathode, a first control electrode for controlling the electron current emitted by said cathode, first and second output electrodes and a second control electrode for controlling the distribution of current between said output electrodes, the potentials of said first output electrode of the first valve and said first control electrode of the second valve being maintained constant relative to said cathodes, input means coupled to said first control electrode of the first valve, additional input means coupled to both of said second control electrodes, and output means coupled to said second output electrode of the first valve and to said first output electrode of the second valve.

2. A thermionic valve circuit as defined in claim 1, said second control electrodes being directly connected together.

3. A thermionic valve circuit as defined in claim 1, said second output electrode of the first valve and said first output electrode of said second valve being directly connected together.

4. A thermionic valve circuit as defined in claim 1, said two valves having substantially identical characteristics and mean operating conditions.

5. A thermionic valve circuit comprising in combination two valves of the pentode type each having a cathode, control grid, screen, suppressor, and anode, the potentials of the screen of the first valve and the control grid of the second valve being maintained constant relative to said cathodes, said suppressors being connected together and said anode of the first valve and screen of the second valve being connected together, input means coupled to said control grid of the first valve, additional input means coupled to said suppressors, and output means coupled to said connected anode and screen.

6. In combination with a cathode ray tube of the type having asymmetric deflection in two mutually perpendicular directions, two thermionic valve circuits as defined in claim 1, each of said circuits having its output coupled to said tube, means for applying sine wave potentials in quadrature to said first-named input means of said circuits to produce rotation of the beam at constant angular velocity, and means for simultaneously applying potentials to said second-named input means of said circuits to produce radial deflections.

7. An electrical circuit comprising in combination means to produce a first electron discharge stream, a signal input electrode and a pair of output electrodes therefor, load impedance means connected to one of said output electrodes, a volume control electrode adapted to vary the relative distribution of electron space current upon said output electrodes, means to produce a second electron discharge stream, a pair of output electrodes therefor, a volume control electrode adapted to vary the relative distribution of electron space current upon said last mentioned output electrodes, means for applying a signal control potential to said input electrode and for deriving output potential from said load means, means for applying further control potential to both said volume control electrodes, and further means to pass additional output current from one of the output electrodes of said second discharge stream through said load impedance, whereby to

compensate for the changes of average output current due to variations of space current of said first electron stream.

8. An electrical circuit comprising in combination means to produce a first and a second electron discharge stream, individual output electrodes for each discharge stream, a signal input electrode for said first discharge stream, a signal input circuit connected to the input electrode and a signal output circuit connected to both said output electrodes, means including a further con-

5 trol electrode for each of said discharge streams for varying the steady discharge currents to said output electrodes in an opposite sense in accordance with a control potential simultaneously applied to said further control electrodes, whereby to maintain the steady current through said output circuit substantially constant independently of said control potential.

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