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TRIGGER CIRCUITS

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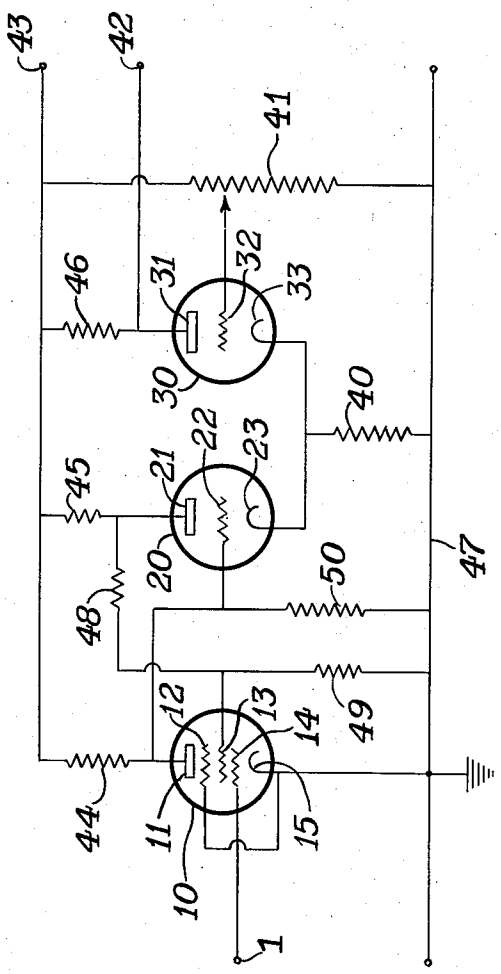

Fig. 1

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TRIGGER CIRCUITS

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1 Claim. (Cl. 250—27)

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This invention relates to an improved thermionic trigger arrangement and more particularly to a new trigger circuit having two thermionic tubes connected asymmetrically with each other and comprising a third thermionic tube, whereby the output circuit is isolated from the input circuit and whereby an output of high amplitude is obtainable at an uncommonly low input amplitude differential.

Thermionic trigger circuits of the past have been built according to the principle of the Eccles-Jordan arrangement, as disclosed in British Patent 148,582, which is characterized mainly by a symmetric coupling of two thermionic tubes such as, for instance, from the anode of a first tube to the control grid of a second tube and from the anode of the second tube to the control grid of the first. Or pentode trigger pairs are used for this purpose having the anode of the first tube connected to the screen grid of the second tube and the anode of the second tube to the screen grid of the first. In response to a positive voltage applied, one of the tubes becomes conducting. The ensuing potential drop in the anode circuit of this tube causes the potential between the grid and the cathode of the other tube to become more negative and to hold this other tube non-conducting until the negative movement of the input voltage sufficient to raise the potential between the grid and the cathode of this other tube above a given minimum reverses the conditions in that now this other tube conducts, thereby causing the potential between the grid and the cathode of the first tube to become more negative so that this tube is now rendered non-conducting until the system again reverts under the influence of the next succeeding increase in input voltage. In the well-known Schmitt trigger circuit coupling is from the anode of a first tube to the control grid of a second tube and from the cathode of the second tube to the cathode of the first tube. Some of the trigger arrangements mentioned need a negative voltage supply in order to operate and some need compensating condensers if high speed of response is required.

The thermionic trigger circuit of the present invention comprises numerous advantages not found in the aforementioned prior trigger arrangements. Thus, it provides for triggering in either direction from one state of equilibrium to another at a lower hysteresis of the input potential. The output circuit is almost completely isolated from the input circuit whereby the output stability is greatly improved. A supply of negative voltage and the necessity of using compensating condensers is entirely dispensed with. The circuit is capable of operation at higher speed and of yielding an output signal of higher amplitude. In addition, the present trigger circuit is superior in being adjustable by means of a single control and in being more simple in construction.

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Referring to the accompanying drawing, one embodiment of the trigger circuit is shown there which comprises three thermionic tubes, designated as 10, 20, and 30. The tube 10 is preferably a pentode although the suppressor grid 12 of a pentode is not an absolute requirement for the hereindisclosed purpose. The tubes 20 and 30 are preferably triodes, although multigrid tubes may be used if desired. The tubes are connected in such a manner that a conductor is provided between the anode 11 of tube 10 and the control grid 22 of tube 20. Another conductor joins the anode 21 of tube 20 with the screen grid 13 of tube 10. The tube 30 is made part of the trigger arrangement by connecting its cathode 33 to the cathode 23 of tube 20 and connecting both cathodes to a common cathode resistor 40, the other end of which is connected to a ground conductor 47. In this manner it is possible to maintain the cathodes 23 and 33 of the second and of the third tube, respectively, at all times at a substantially positive voltage which, in turn, permits the direct connection between the control grid 22 of the second tube with the anode 11 of the first tube without the need of a source supplying negative voltage, provided that the anode voltage of tube 10 is prevented from rising so high as to cause the grid 22 of tube 20 to become more positive than its cathode 23. This can be done by making the anode supply voltage of tube 10 less than that of tube 20 by using a voltage divider such as the resistors 44 and 50 shown in the drawing or by other means well known in the art. The control grid 32 of tube 30 is held at a fixed potential, regulated by a potentiometer 41, or by other means, which serve the purpose of providing a control whereby the trigger arrangement can be adjusted for the desired input sensitivity or output amplitude. Whereas, according to the here disclosed arrangement, the tubes 10 and 20 are out of phase, the tube 30 operates in phase with tube 10. In the illustrated embodiment the output voltage 42 is developed across the resistor 46 and is taken off the anode 31 of tube 30, while the input voltage 1 is applied between the cathode 15 and the control

grid 14 of tube 10. Thus, a practically complete separation is obtained between input and output. The output voltage can be taken from other points than 31 if complete isolation from the input is not essential. For example, an output from anode 21 of tube 20 will yield an output in the same phase as the input. Plate current is supplied from the source 43, the negative terminal of which is connected to the ground conductor 47, and is carried to the anodes of the respective tubes through conductors having the resistors 44, 45, and 46 inserted prior to the anodes. Other resistors are the resistor 48 between the anode 21 of tube 20 and the screen grid 13 of tube 10, which may be made zero if desired, the resistor 49 from screen grid 13 of tube 10 to ground, which may be omitted if the screen wattage of tube 10 is not exceeded, and the resistor 50 from control grid 22 of tube 20 to ground.

The principle of the invention will be understood when reading in connection with the drawing the fo lowing description of what is believed to take place. The circuit arrangement has two states of equilibrium. In the first state tube 10 and tube 30 are passing very little anode current, while tube 20 is passing a large anode current. In the second state tube 20 is passing very little anode current, while tubes 10 and 30 are passing a large anode current. Assuming, for purposes of the present discussion, that at a given moment the input potential has decreased below a critical inferior "triggering" input potential and the trigger arrangement is in the first state of equilibrium, where the tube 20 is passing a large anode current, the potential of the grid 14 with respect to the cathode 15 of tube 10 is more negative than the inferior critical voltage. As the input voltage becomes more positive, the potential of the grid 14 of tube 10 increases until a superior critical potential is reached, at which potential the circuit regenerates. That is, the anode voltage of tube 10 in falling has reduced the grid voltage of tube 20, reducing its plate current and raising its plate voltage which, in turn, raises the screen grid voltage of tube 10. This causes the anode potential of tube 10 to fall still further. The regenerative action occurs almost instantaneously, being delayed only by the time required for the stray capacity of the circuit to charge through the associated resistance. After this regeneration the circuit is in the second state of equilibrium, where tube 20 is passing very little anode current. When the input now reduces towards a negative potential, very little change occurs until the inferior critical potential is reached, where the circuit again regenerates to the first state, in a manner analogous to that described above. The tube 30 operates in phase with tube 10, because the common cathode resistor 40 by means of which tube 30 is coupled with tube 20 causes the anode current of tube 30 to decrease whenever the anode current of tube 20 increases. To obtain the largest possible output amplitude at low input differential is a matter of selecting the resistors 40, 44, 45, 46, 48 and 49 and adjusting the potentiometer 41. For example, with the circuit constants shown below, the yield is an output of 60 volts at an input differential of <0.1 volt.

Tube 10	6AK5
Tubes 20+30	6J6

Plate current supply 43	225 volts
Cathode resistor 40	68,000 ohms
Potentiometer 41	50,000 ohms
Resistor 44	10,000 ohms
Resistor 45	2,500 ohms
Resistor 46	5,000 ohms
Resistor 48	0
Resistor 49	Infinite
Resistor 50	10,000 ohms

The herein disclosed circuit has also been made to operate very satisfactorily by using a 6AC7 for tube 10 and 6SN7 for tubes 20 and 30.

Since the potential of the grid 32 of tube 30 is adjusted to make the circuit trigger properly, it is evident that by a different adjustment of the potential of grid 32 the trigger circuit can be made inoperative. In many trigger circuit applications, such as counter circuits for instance, it is desirable to render the circuit inoperative for certain time intervals. This can be readily accomplished by coupling an external signal voltage onto the grid 32 to add or to subtract from the D. C. voltage as adjusted for proper triggering.

Ramifications of the circuit such as the one just described will be apparent to those skilled in the art, and the invention is not intended to be limited to the exclusion of such ramifications.

In addition to the aforedisclosed intrinsic advantages, the new trigger arrangement is of enhanced usefulness in instances where the high speed switching action of a trigger circuit is desired, but compactness and simplicity are also required.

I claim:

A thermionic trigger arrangement comprising three thermionic tubes, each having an anode, a cathode, and at least one control grid, the first of the said tube having in addition at least one auxiliary control grid, an input circuit connected between the cathode and the control grid of the said first tube, circuit means interconnecting the anode of the said first tube with the control grid of a second of the said three tubes and the anode of the said second tube with the auxiliary control grid of the said first tube, circuit means, including a common cathode resistor, interconnecting the cathode of the said second tube with the cathode of the third of the said three tubes, means to hold the control grid of the said third tube at a fixed potential, anode current supply means providing a large anode current in said second tube when the input potential drops below an inferior critical level until it passes a superior critical level, providing a large anode current in said first and third tube when the input potential passes the superior critical level until it falls below the inferior critical level, and an output circuit comprising an impedance connected to the anode of the said third tube.

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