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H. N. BEVERIDGE ET AL
PULSE WIDTH DISCRIMINATOR

2,776,370

Filed June 27, 1952

2 Sheets-Sheet 1

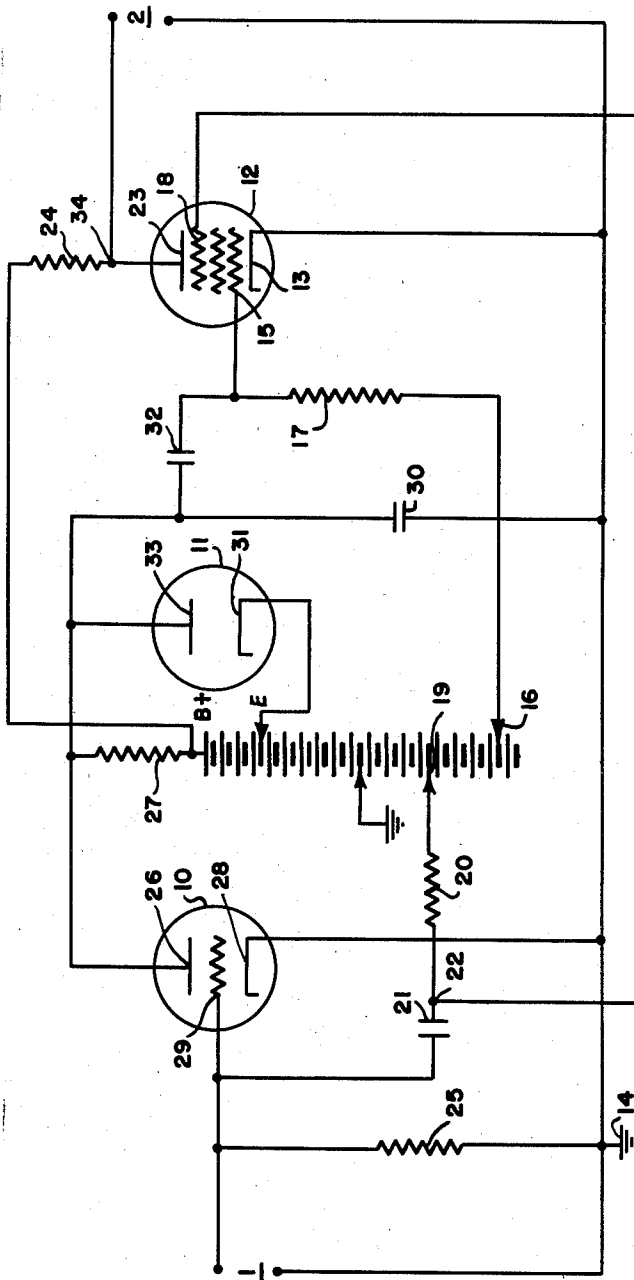


FIG. 1.

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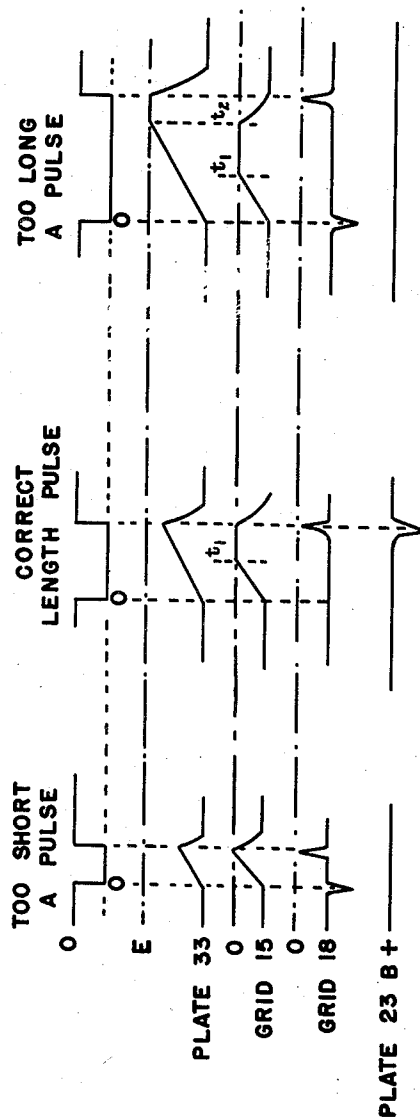


FIG. 2.

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PULSE WIDTH DISCRIMINATOR

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2 Claims. (Cl. 250—27)

This invention relates to electronic circuits having discriminatory response characteristics and more particularly to an electronic circuit for pulse time duration discrimination.

In many electronic fields, such as television for example, it is desired that an electronic receiver respond only to selected intelligence arriving from a particular source, all other electrical variations no matter what the source, are to be ignored by the receiver. To shield the receiver from the undesirable variations, an intervening circuit is provided with the ability of processing all variations that it receives and passing on to the receiver variations in accordance with favored signals only.

An object of this invention is to provide a circuit which is responsive to potential variations or impulses falling between certain time duration limits only.

Another object of this invention is to provide an intervening circuit between a source of potential variations and a receiver which will, in effect, interview all incoming signals comprising potential variations or impulses and pass on to the receiver signals in accordance with favored incoming signals only.

Other objects and many attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a schematic diagram of one embodiment of the invention; and

Fig. 2 is a series of graphical illustrations showing instantaneous voltage variations occurring simultaneously in several parts of the circuit.

There is shown in Fig. 1 a tube 12 which is the output tube of a preferred embodiment of this invention and is arranged so that its cathode 13 is connected to a zero reference potential such as ground 14. The control grid is provided with a substantial negative cutoff bias by connection to tap 16 of the battery supply through resistor 17. A second grid 18 is maintained at a negative cutoff bias of less value than that applied to grid 15 by connection to tap 19 through resistance 20. The tube is thereby maintained in a quiescent non-conducting condition. The plate 23 of the output tube 12 is connected to B+ through a resistor 24. The voltage at plate 23 is B+ most of the time being less when the tube 12 is conducting. This occurs only when both the grids 15 and 18 are at respective potentials that permit the tube to conduct. At that time, the plate voltage drops because of the IR drop in resistance 24. Fig. 2 graphically illustrates the voltage on plate 23 for several operating conditions.

The input tube 10 operates at a zero grid bias, the grid being grounded through resistor 25. The plate 26 is connected to B+ through resistor 27 and cathode 28 is grounded. The tube is normally fully conducting whereby it operates at a plate voltage of only a few volts. When a negative pulse is received at the input 1, the

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grid 29 is instantaneously biased below cutoff whereby the tube 10 stops conducting.

An RC differentiating circuit comprising a condenser 21 and a resistor 20 is connected between grid 29 and negative bias tap 19. The time constant of the RC circuit is much smaller than the width of an input pulse. A differentiated output is obtained at 22, namely a negative spike coincident with the leading edge and a positive spike coincident with the trailing edge of an input pulse. This is shown in Fig. 2. These spike-like pulses are applied to the grid 18 of tube 12 whereby the latter grid is raised momentarily above cutoff when the positive spike is applied to the grid. The effect of this arrangement is that the output tube can only conduct coincident with the trailing edge of an input pulse provided current flow is not otherwise blocked.

The grid 15 must be raised above cutoff before the output tube 12 can conduct. This is accomplished by the cooperation of the RC circuit 17, 32 with condenser 30 and diode 11. The time constant of RC circuit 17, 32 is greater than pulse width. This circuit unbiases the grid 15 so that the tube can conduct when the tube is not otherwise blocked.

When the tube 10 is cut off by an input pulse, the condensers 30 and 32 begin to charge. Grid 15 is carried to ground at the same rate as plate 33 is carried toward B+. At time t_1 on Fig. 2 the grid side of condenser 32 reaches ground potential. As a result grid 15 begins to act as a diode plate and conducts to ground limiting any further positive rise of grid 15. This conduction also has the effect of connecting the right side of condenser 32 to ground. The total charging capacity at the plate of tube 10 is increased approximately from C_{30} to $C_{30} + C_{32}$. The voltage at plate 33 of diode 11 continues to rise, although somewhat more slowly. The constants of the circuit are so chosen that the positive charging current through condenser 32 exceeds the negative current

$$\frac{V_{16}}{R_{17}}$$

thus holding the grid 15 clamped to ground.

Diode 11 serves to terminate the charging of the condensers 30 and 32. The plate 33 of the diode is connected to plate 26 of input tube 10. Its cathode 31 is connected to a selected positive potential somewhere below B+. When condensers 30 and 32 have charged to the potential where the diode plate is at the potential of cathode 31, the diode begins to conduct. Since the condenser 32 then stops charging, the voltage on grid 15 decays rapidly back to the voltage of tap 16. The particular voltage at which the tube 11 begins to conduct depends upon the potential selected for its cathode 31. By this means, the period during which grid 15 of tube 12 remains clamped to ground may be varied somewhat.

The net result of all this is that a "gate" voltage is developed on the grid 15, this voltage being zero between times t_1 and t_2 and negative at all other times; see Fig. 2.

The voltage on the grid 18 of tube 12 at times corresponding to the leading and trailing edges of the input pulse is the differentiated input pulse, the positive spike due to the trailing edge raising grid 18 above cutoff. Therefore if the trailing edge occurs between times t_1 and t_2 both grids 15 and 18 will be simultaneously turned on and tube 12 will conduct thereby producing an output pulse at 34. This coincidence condition will occur only when the pulse width lies between t_1 and t_2 . In this way the pulse width discriminator action is produced.

It is to be noted that this circuit will not trigger on two short pulses spaced the proper width apart; the fact that the pulse must be present for a certain length of time to cause the "gate" to open gives the circuit an in

tegrating function which improves the useful signal to noise ratio of the system in which it is used.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

We claim:

1. In a pulse width discriminator circuit; a power supply; a multi-element input tube having at least one grid; a first resistor connected at one end to the plate of said input tube, the other end of said first resistor and the cathode of said input tube being coupled to said power supply whereby plate supply potential is provided to said input tube; means connected in circuit with said input tube whereby said input tube is normally fully conducting; a condenser connected between the plate and cathode of said input tube; an RC circuit, the condenser end of said RC circuit being connected to the plate of said input tube, the resistor end of said RC circuit being so connected to said power supply whereby it is at a potential below that of the cathode of said input tube; a diode whose plate is connected to the plate of said input tube and whose cathode is so connected to said power supply whereby it is at a potential above that of the plate of said input tube when said input tube is fully conducting but is below the plate supply potential of said input tube; an output tube having at least a control grid, the cathode of said output tube being connected to the cathode of said input tube; a third resistor connected between the plate of said output tube and said power supply whereby said output tube is provided with plate supply potential; the grid of said output tube being connected to the junction between the resistor and condenser of said RC circuit whereby said output tube is normally biased beyond cutoff; whereby the application of a negative pulse between the grid and cathode of the input tube cuts off the input tube causing the potential across said first-mentioned condenser and the potential of the grid of said output tube to rise at substantially the same rate, the potential of the grid of said output tube rising to a maximum potential equal to the potential of the cathode of said output tube at which potential the grid of said output is above cutoff, the grid of said output tube remaining above cutoff until said second condenser is charged to the potential at which said diode conducts at which time the grid of said output tube drops below cutoff, the grid of said output tube dropping below cutoff at an earlier time coincident with the trailing edge of an input pulse if that occurs before said diode conducts.

2. A pulse width discriminator circuit comprising; a power supply; a multi-element input tube having at least one grid; a first resistor connected at one end to the plate of said input tube, the other end of said first resistor and the cathode of said input tube being coupled to said power supply whereby plate supply potential is provided to said input tube; means connected in circuit with said input tube whereby said input tube is biased to be normally fully conducting; a first RC circuit of very short time constant compared to a predetermined acceptable range of input pulse width, the condenser end of said RC circuit connected to the grid of said input tube, the resistor end of said RC circuit being

so connected to said power supply whereby it is at a potential below that of the cathode of said input tube; a second condenser connected between the plate and cathode of said input tube; a second RC circuit of somewhat longer time constant than the predetermined acceptable range of pulse width, the condenser end of said second RC circuit being connected to the plate of said input tube, the resistor end of said second RC circuit being so connected to said power supply whereby it is at a potential below that of the cathode of said input tube; a diode whose plate is connected to the plate of said input tube and whose cathode is so connected to said power supply whereby it is at a potential above that of the plate of said input tube when said input tube is fully conducting but is below the plate supply potential of said input tube; an output tube having at least a first and a second grid, the cathode of said output tube being connected to the cathode of said input tube; a fourth resistor connected between the plate of said output tube and said power supply whereby said output tube is provided with plate supply potential; the second grid of said output tube being connected to the junction between the resistor and condenser of said first RC circuit whereby said output tube is normally biased beyond cutoff; the first grid of said output tube being connected to the junction between the resistor and condenser of said second RC circuit whereby said output tube is normally biased beyond cutoff; whereby the application of a negative pulse between the grid and cathode of the input tube cuts off the input tube causing the potential across said second condenser and the potential of the first grid of said output tube to rise at substantially the same rate, the potential of the first grid of said output tube rising to a maximum potential equal to that of the cathode of said output tube at which potential the first grid is above cutoff, the first grid remaining above cutoff until said second condenser is charged to the potential at which said diode conducts at which time the first grid drops below cutoff, the first grid dropping below cutoff at an earlier time coincident with the trailing edge of an input pulse if that occurs before said diode conducts, the second grid of said output tube being raised to a potential above cutoff coincident the trailing edge of an input pulse whereby a negative-going output pulse is developed between the plate and cathode of said output tube whenever a negative input pulse falling within the predetermined acceptable range of pulse width is applied between the grid and cathode of said input tube.

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