

# A Linear Bidirectional Two-Pentode Gate

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## ABSTRACT

A new gate circuit of cathode-follower type has been described. The circuit works both as coincidence and anticoincidence gate and is suitable for general use.

## Introduction

A gate has two states, in one of which (gate open) the output is reasonable reproduction of the input, and in the other (gate shut) there is no output. The transition from one state to the other is generally controlled by a square pulse applied to an auxiliary input.

A gate may be unidirectional or bidirectional depending on whether it passes input signal of one polarity or both.

Many gate circuits are given in the text books.<sup>1,2,3,4</sup> But these are suitable for their specific use only due to their one or more inherent limitations. In the present paper, the design of a two-pentode general purpose gate has been given. The circuit has the following significant features:

- (1) It performs the jobs of both coincidence and anticoincidence gate.
- (2) Since it is of cathode-follower type, it is a linear bidirectional gate having no problem of impedance matching with other circuits.
- (3) It has negligible leakage.
- (4) It is very simple in construction.

## Description

The circuit is designed by coupling two similar sharp cut-off pentodes. These pentodes are properly biased by the coupling resistor and negative power supply. The screen grids are maintained at zero and positive voltages respectively to make the tube  $V_1$  off and  $V_2$  on.

Initially the circuit transmits the signal only if it is applied on the control grid of  $V_2$  because

$V_1$  is off and  $V_2$  is on. When the selector pulses of opposite polarities are applied to the screen grids, the state of the circuit is changed for the time interval  $T_p$  in which the tube  $V_1$  is on and  $V_2$  off, and the circuit becomes suitable for transmission of the signal of  $V_1$  also. Thus the circuit has two states out of which only one is suitable for transmission of the signal of  $V_1$  or  $V_2$  and works as a gate.

As shown in Fig. 1, the signal may be applied either on the control grid of  $V_1$  or  $V_2$  depending on whether the circuit is to work as a coincidence gate or anticoincidence gate. These names are in consistence with two performances of the circuit in which the output signal may or may not be in coincidence with the selector pulses.

Since the circuit works as a cathode-follower during the time the signal is transmitted to the output, the gain, input impedance and output impedance of the circuit are given by the following usual relations of a cathode-follower<sup>5</sup>.

$$\begin{aligned} \text{Gain} &= \frac{\mu R_k}{r_p + (\mu + 1) R_k} \\ &\approx \frac{g_m R_k}{1 + g_m R_k} \end{aligned}$$

$$\text{Input Impedance} = R_k$$

$$\text{Output Impedance} = \frac{r_p R_k}{r_p + (\mu + 1) R_k}$$

$$\approx \frac{R_k}{1 + g_m R_k}$$

$$\approx \frac{1}{g_m} \quad (\text{Since all practical circuits have } g_m R_k \gg 1)$$

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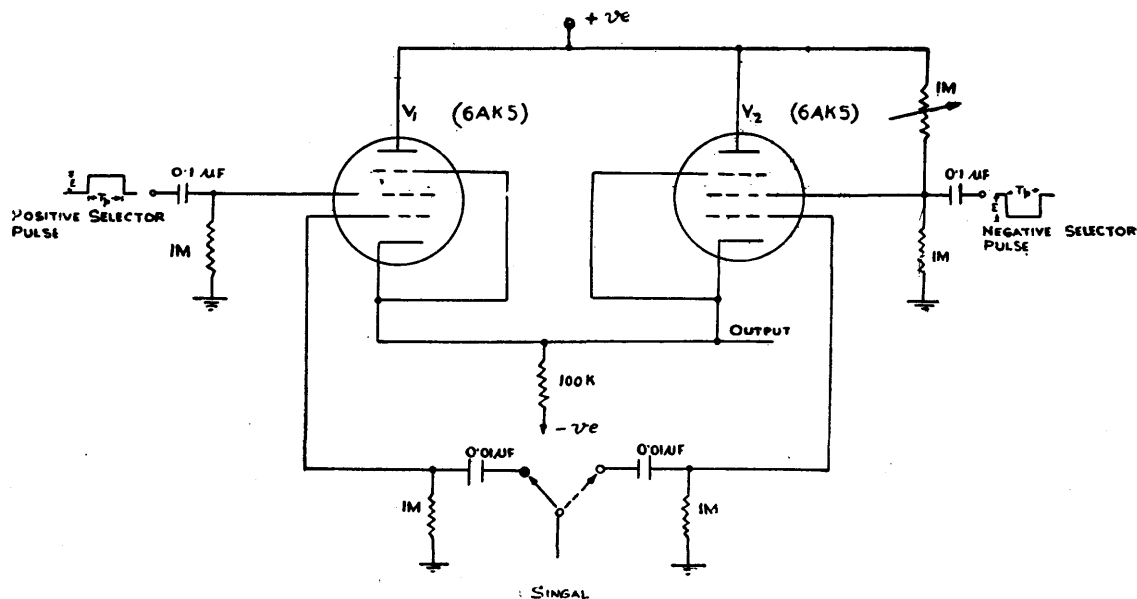


Fig. 1

Here  $\mu$  and  $r_p$  are the amplification factor and plate resistance of each pentode,  $R_g$  is the control grid resistance, and  $R_k$  is the cathode coupling resistance.

In the design of the circuit, the values of  $R_k$  and  $R_g$  should be taken large to attain high gain and input impedance while the values of coupling capacitors are determined by the frequency of the signal and the pulse width of the selector pulses.

### Discussion

The circuit has been assembled and tested. The selector pulses have been taken from a multivibrator and the signal from an audio oscillator. It has been found that the positive voltage of the screen grid should be properly adjusted to remove the pedestal and the negative supply voltage, to get the exact reproduction of the input signal in the output. Moreover, the two selector pulses should be similar in all respects (pulse width, rise time, etc.) except for polarity.

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