

Jan. 22, 1952

M. I. JACOB
KEYING SYSTEM

2,583,146

Filed Aug. 6, 1949

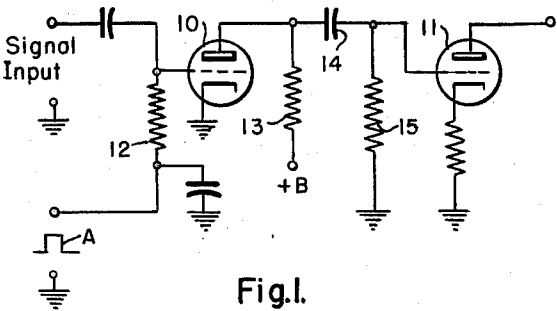


Fig. 1.

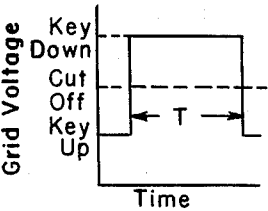


Fig. 2.

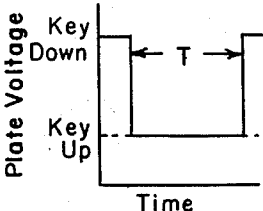


Fig. 3.

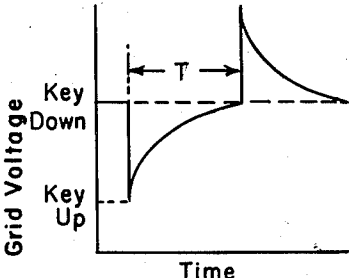


Fig. 4.

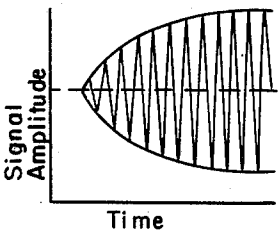


Fig. 5.

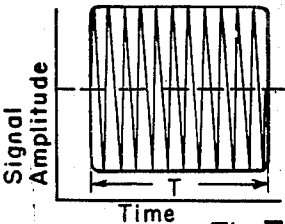


Fig. 7.

WITNESSES:
E. A. McEliskey
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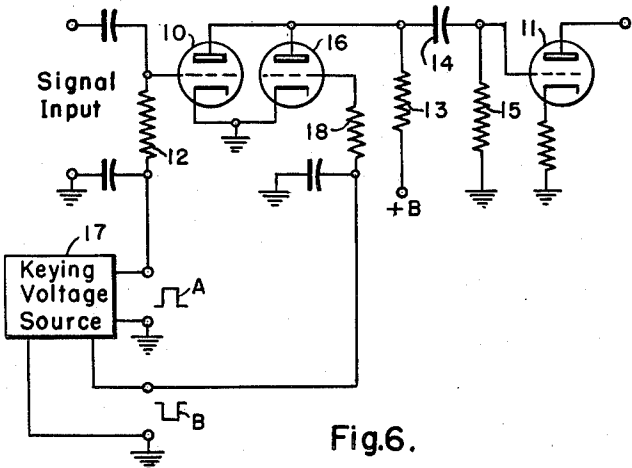


Fig. 6.

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2,583,146

KEYING SYSTEM

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Application August 6, 1949, Serial No. 108,961

4 Claims. (Cl. 250-27)

1

This invention relates to the electronic keying of resistance coupled speech amplifiers used in radio transmitters, and it has as an object the maintenance of a steep wave front at the output of such an amplifier during electronic keying thereof, without the presence of spikes or clicks.

Resistance coupled amplifier circuits are commonly used in the speech amplifiers of radio transmitters. In the past it has been impractical to electronically key such amplifiers for the reason that the time delays caused by the time constants of the resistance coupled circuits limit the keying speed to an impractical number of words per minute and have caused spikes at the grids of the amplifier tubes following the keyed tubes, resulting in objectionable audible clicks. For this reason it has been the practice in the past where resistance coupled amplifiers were used, to either key such amplifiers with relays, or to key audio frequency oscillators ahead of the amplifiers. Keying by relays involves additional first cost and increased maintenance expense, and the keying of audio oscillators has resulted in undesired lulls in the outputs of the amplifiers.

According to this invention, instead of keying a resistance coupled amplifier by applying blocking bias pulses to the control grid of a single vacuum tube which is resistance coupled to a following tube, out-of-phase blocking bias pulses are applied simultaneously to the control grids of two similar tubes, the plates of which are interconnected and the cathodes of which are interconnected. Thus one tube conducts while the other is cut-off. This results in a constant D. C. voltage at the plates of the tubes during the keying, and this, in turn, results in constant bias voltage and therefore a square wave of audio frequency potential at the plate of the following tube.

The invention will now be described with reference to the drawing, of which:

Figure 1 is a circuit schematic illustrating how resistance coupled amplifiers have previously been electronically keyed;

Fig. 2 is a graph illustrating the D. C. voltages at the grid of the keyed tube of Fig. 1 during the keying;

Fig. 3 is a graph illustrating the D. C. voltages at the plate of the keyed tube of Fig. 1 during the keying;

Fig. 4 is a graph illustrating the D. C. voltages at the control grid of the tube following the keyed tube of Fig. 1 during the keying;

Fig. 5 is a chart illustrating the wave form

2

during keying of the audio frequency signal at the plate of the following tube of Fig. 1;

Fig. 6 is a circuit schematic of one embodiment of this invention, and

Fig. 7 is a chart illustrating the wave form during keying of the audio frequency signal at the plate of the tube following the keyed tubes of Fig. 6.

Referring now to Fig. 1 of the drawing, the triode, input tube 10 is resistance coupled to the triode, following tube 11. The audio frequency signal input is applied between the grid of the tube 10 and its grounded cathode. The keying pulse is applied through the grid resistor 12 to the grid of the tube 10 and through ground to its cathode, and has the shape shown at A. Normally the tube 10 is biased to cut-off so that no signal will appear at its plate, and no plate current will flow through the plate resistor 13.

The D. C. biasing voltages at the grid of the tube 10 resulting from the keying pulses are shown by Fig. 2. The positive pulse of voltage at the grid of the tube 10 when the key of the keyer is down, causes the tube 10 to conduct so that the signal appears at its plate during the period T. The flow of plate current through the plate resistor 13 causes a voltage drop therein resulting in the D. C. voltage at the plate of the tube 10 decreasing as shown by Fig. 3. This causes a D. C. pulse to be applied to the grid of the tube 11. Due, however, to the time constant of the coupling capacitor 14 and the grid resistor 15, the D. C. voltage appearing at the grid of the tube 11 is that shown by Fig. 4. This voltage represents a bias change on the grid of the tube 11 which results in its output signal having the wave shape shown by Fig. 5. This varying output not only limits keying speed noticeably, but also objectionable clicks are produced by the spikes shown by Fig. 4 at the end of the pulses. These undesired effects are eliminated by the circuit shown by Fig. 6 which will now be described.

The circuit of Fig. 6 is similar to that of Fig. 1 except that the tube 16 has been added, with its cathode and plate connected to the cathode and plate, respectively, of the tube 10, and the keying voltage source 17 which supplies the pulse A to the grid of the tube 10, supplies a similar out-of-phase pulse B, through the grid resistor 18, to the grid of the tube 16. The tubes 10 and 16 thus conduct alternately, the tube 10 conducting when the key of the keyer is down, and the tube 16 conducting when the key is up.

The tubes 10 and 16 should be similar and

3

matched so that they draw the same plate current when conducting. As a result, the D. C. voltage at their plates remains constant throughout the keying so that there are no pulses applied to the grid of the following tube 11. As a result, the output signal has the wave form shown by Fig. 7 of the drawing instead of that shown by Fig. 5.

In an actual application of this invention to a radio transmitter, it was possible to provide modulated, continuous wave keying at speeds of up to one hundred words per minute.

It should be apparent that the tubes 10 and 16 could be tube units contained in one tube envelope.

I claim as my invention:

1. An electronic keying circuit comprising two, similar, electron tube units having plates directly connected together, having cathodes directly connected together, and having control grids; an electron tube having a control grid, resistance coupled to said plates, and keying means for applying direct current biasing pulses to the control grid of one of said units, and for applying direct current biasing pulses, out-of-phase with said pulses, to the control grid of the other of said units.

2. An electronic keying circuit comprising two, similar, electron tube units having plates directly connected together, having cathodes directly connected together, and having control grids; means for applying an input signal between the control grid and cathode of one of said units; an electron tube having a control grid, resistance coupled to said plates, and keying means for applying direct current biasing pulses to the control grid of one of said units, and for applying direct current biasing pulses, out-of-phase with said pulses, to the control grid of the other of said units.

3. An electronic keying circuit for a resistance coupled, speech amplifier of a radio transmitter having an input, electron tube unit with a control

4

grid and a cathode connected to receive an input signal, and having a plate, resistance coupled to the control grid of a following electron tube, comprising an electron tube unit similar to said input tube unit, and having its plate and cathode directly connected to the plate and cathode respectively, of said input tube unit, and keying means for applying direct current biasing pulses to the control grid of one of said units, and for applying direct current biasing pulses, out-of-phase with said pulses, to the control grid of the other of said units.

4. In combination with a resistance coupled speech amplifier of a radio transmitter, said amplifier having an input electron tube unit with a control grid and a cathode connected to receive an input signal, and having a plate, resistance coupled to the control grid of a following electron tube; an electron tube unit similar to said input tube unit, and having a plate and a cathode directly connected to the plate and cathode respectively, of said input tube unit, and having a control grid, and keying means for applying direct current biasing pulses to the control grid of one of said units, and for applying direct current biasing pulses, out-of-phase with said pulses, to the control grid of the other of said units.

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