

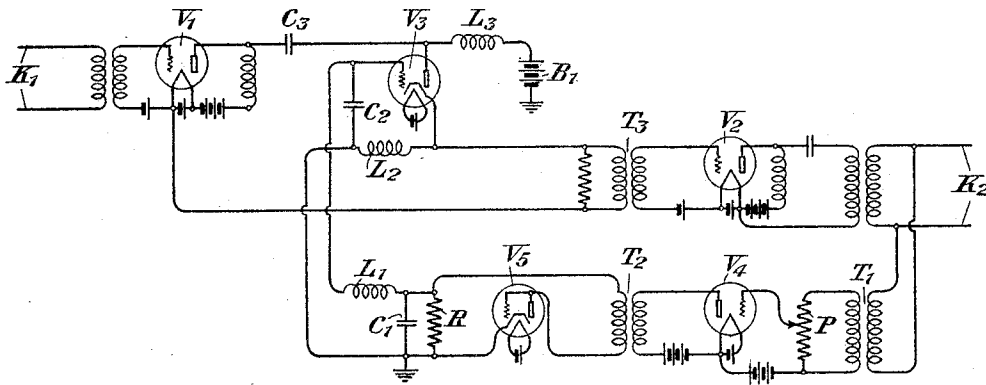
March 21, 1933.

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1,902,030

GAIN CONTROL APPARATUS

Filed Dec. 16, 1930



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# UNITED STATES PATENT OFFICE

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## GAIN CONTROL APPARATUS

Application filed December 16, 1930. Serial No. 502,824.

This invention relates to signaling systems. More particularly, this invention relates to apparatus for the control of the level of signaling energy.

5 One of the objects of this invention is to automatically control the gain of a signal translating system. Another of the objects is to maintain the level of signaling energy constant in value or variable within very narrow  
10 limits.

The arrangements of this invention are believed to have many advantages over prior arrangements for the control of the gain of signaling systems. The elements are so set  
15 up as to cause substantially no modulation or distortion of the transmitted signals or currents, the gain of which the apparatus is intended to control. Especially will the modulation or distortion be negligible if the level  
20 of the transmitted signals is quite low. This invention is particularly adaptable to voice frequency circuits and, in general, to multi-channel carrier amplifiers or other systems. No moving parts are required.

25 This invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention merely for the purpose  
30 of illustration.

Referring to the drawing, the reference characters  $V_1$  and  $V_2$  designate two vacuum tubes forming an amplifying system, the gain of which is to be automatically controlled.  
35 This amplifying system transmits signaling currents from an input circuit  $K_1$  to an output circuit  $K_2$ . A tube  $V_3$  of the heater type forms an essential element of the control apparatus, as will become apparent from the detailed description hereinafter following, and  
40 it will be shown that the plate electrode and the heater of tube  $V_3$  are connected in series in a circuit interposed between the vacuum tubes  $V_1$  and  $V_2$ . The impedance between  
45 these elements will be varied in accordance with the level of energy transmitted by the system.

Part of the energy in the output circuit  $K_2$  is transmitted to the amplifier  $V_4$  through  
50 a transformer  $T_1$  and a potentiometer  $P$ .

The amplified energy is then transmitted through another transformer  $T_2$  to a rectifying tube  $V_5$  which is also of the heater type. The rectifying circuit includes the secondary  
55 winding of the transformer  $T_2$ , the plate electrode and the cathode of the tube  $V_5$  and a resistance  $R$ . The rectified current will produce a voltage across the terminals of the resistance  $R$  and this voltage will vary in accordance with the level of the energy trans-  
60 mitted by circuit  $K_2$  to the amplifier  $V_4$ . It will be shown that as the voltage impressed across the resistance  $R$  increases above or decreases below some predetermined value, cor-  
65 responding changes will be made in the impedance between the plate electrode and the cathode of the tube  $V_3$ .

The grid electrode of the tube  $V_3$  is connected to the upper terminal of the resistance  $R$  through a winding  $L_1$ . Moreover, resist-  
70 ance  $R$  is shunted by a condenser  $C_1$ . The lower terminal of the resistance  $R$  is connected to the heater of the tube  $V_3$  through a winding  $L_2$  and this winding, together with a condenser  $C_2$ , are interposed in a circuit be-  
75 tween the grid electrode of the tube  $V_3$  and its cathode. It will be apparent that the winding  $L_1$  and the condenser  $C_1$  form a section of a low-pass wave filter which is intended to suppress alternating currents in  
80 order that the bias of the grid electrode of the tube  $V_3$  may be effected only by direct current potentials. Other sections may be added to this filter and these will, of course, include further series inductive elements and shunt  
85 capacitive elements.

The plate electrode and the cathode of the tube  $V_3$  are connected in series with the circuit including condenser  $C_3$  and the primary winding of transformer  $T_3$ .  
90 The battery  $B_1$  supplies the necessary positive potential to the plate electrode of the tube  $V_3$  through winding  $L_3$ . The condenser  $C_3$  prevents the potential of the battery  $B_1$  from reaching the plate electrode of the tube  $V_1$ .  
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As the current rectifier by the tube  $V_5$  increases above a predetermined value, the voltage drop in resistance  $R$  will increase above its normal value. Then there will be an in-  
100 crease in the bias of the grid electrode of the

tube  $V_3$ . Hence, the impedance between the plate electrode and the cathode of the tube  $V_3$  will be increased and, consequently, the loss introduced in the circuit interposed between the tubes  $V_1$  and  $V_2$  will be correspondingly increased.

As the rectified current flowing through the resistance  $R$  is reduced below its normal, predetermined value, there will be a corresponding decrease in the bias of the grid electrode of the tube  $V_3$ . Then the impedance between the plate electrode of tube  $V_3$  and its cathode will be correspondingly decreased and the loss interposed in the circuit between the tubes  $V_1$  and  $V_2$  will, accordingly, be reduced.

While this invention has been shown and described in one particular arrangement merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a gain control system, the combination of a circuit transmitting signals, a tube having elements forming a space discharge path and a control electrode, the elements forming the space discharge path being connected directly in series in said circuit, and means responsive to variations in the level of the energy transmitted through said circuit to continuously produce a rectified potential and thereby vary the potential applied to the control electrode of said tube, the control electrode of said tube being affected solely by the rectified potential.

2. In a system for controlling the gain of transmitted signals, the combination of an input circuit, an output circuit, elements forming a space discharge path connected directly in series with said input and output circuits, means for continuously producing a direct current voltage always variable in accordance with the level of the transmitted signals, and means solely responsive to said direct current voltage variations to simultaneously change the impedance of said space discharge path.

3. In a signaling system, the combination of a circuit transmitting signals, a tube having at least three electrodes one of which is a control electrode, two of the electrodes of said tube normally presenting a predetermined impedance and being connected directly in series with said circuit, a source of direct current potential for said control electrode, and continuously acting means responsive to variations in the level of the energy transmitted by said circuit to simultaneously vary the direct current potential applied to said control electrode, said control electrode being affected solely by the varying direct current potential.

4. In a signaling system, the combination of a circuit transmitting signals, a tube having at least three electrodes one of which is a control electrode, two of the electrodes of said tube presenting a space discharge path and being connected directly in series in said circuit, means for continuously rectifying a portion of the current flowing through said circuit, and means for producing a direct current potential of a value proportional to the magnitude of the rectified current and impressing said direct current potential on the control electrode of the tube, said control electrode being affected solely by the magnitude of the rectified current.

In testimony whereof, I have signed my name to this specification this 15th day of December 1930.

WILLIAM H. T. HOLDEN.