

Sept. 10, 1929.

R. S. OHL

1,727,408

CONTROL OF REGENERATION IN SIGNALING SYSTEMS

Filed Feb. 20, 1926

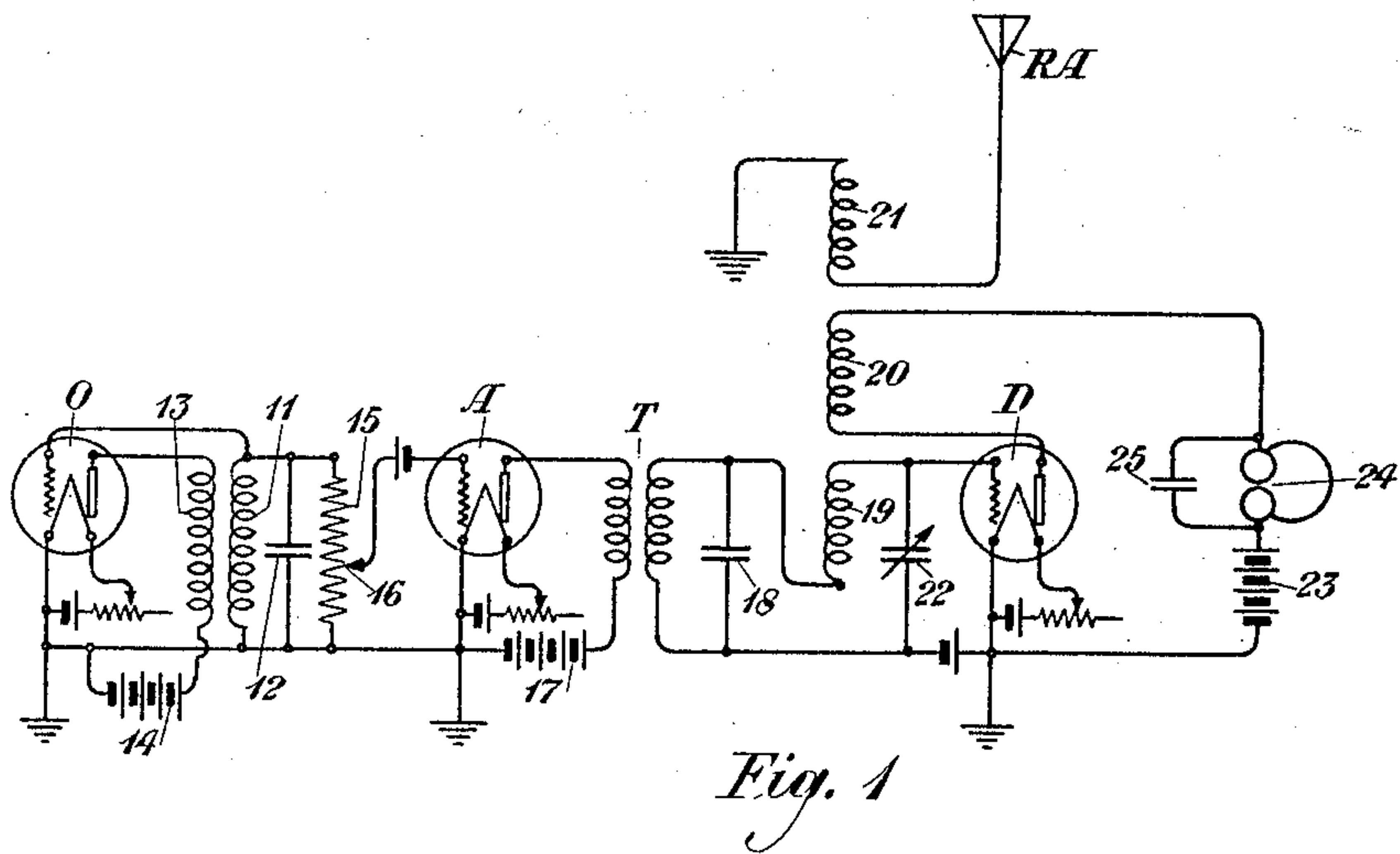


Fig. 1

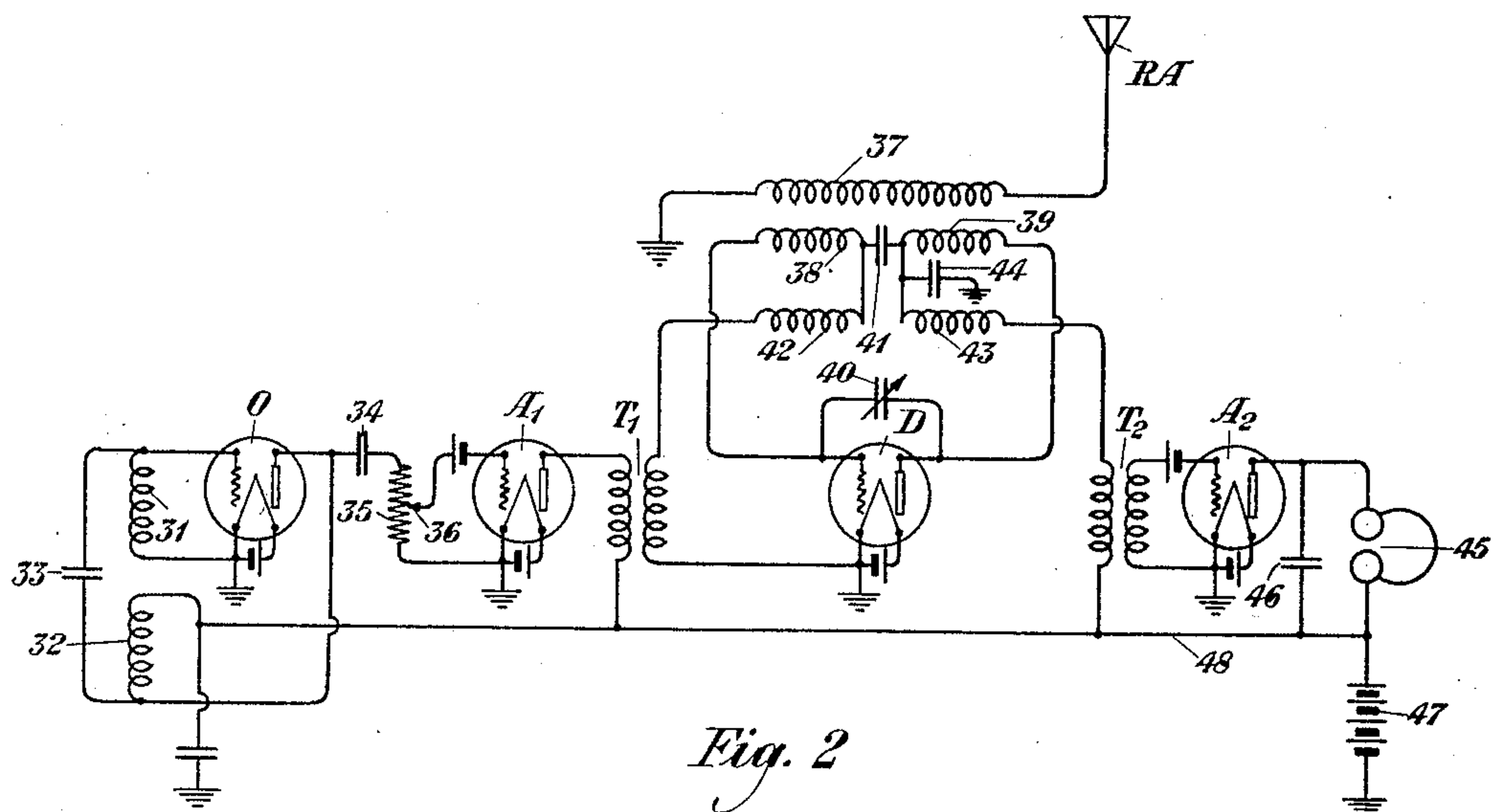


Fig. 2

BY

INVENTOR
R. S. Ohl
g e f o r e
ATTORNEY

UNITED STATES PATENT OFFICE.

RUSSELL S. OHL, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND
TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

CONTROL OF REGENERATION IN SIGNALING SYSTEMS.

Application filed February 20, 1926. Serial No. 89,795.

This invention relates to signaling systems, and particularly to arrangements in regenerative systems for controlling the magnitude of regeneration.

5 In a vacuum tube having an input circuit and an output circuit which are coupled so as to feed energy in the output circuit back to the input circuit, when the coupling is varied so as to control the rate at which
10 energy in the output circuit is fed back to the input circuit, the frequency at which the input circuit is tuned is changed. In order to tune the input circuit to the same frequency that it previously had, it is necessary to make two adjustments, one determining the frequency of the input circuit and the other determining the magnitude of regeneration. The fact that two adjustments are necessary, one involving a change in the
15 frequency of the circuit to control the magnitude of regeneration in a vacuum tube having coupled input and output circuits, makes the system highly undesirable, especially where high frequencies are concerned.

25 It is an object of the invention to control regeneration in a vacuum tube having an input circuit and an output circuit having a fixed coupling therebetween by impressing another frequency on the input circuit and varying the amplitude of this other frequency to control regeneration.

35 It is another object of this invention to receive signals which are modulated on a carrier wave impressed on a vacuum tube set up for regeneration by impressing another wave of constant frequency on the vacuum tube and controlling the regeneration by varying the amplitude of this other wave.

40 While the nature of the invention will be pointed out with particularity in the appended claims, the invention itself, both as to its objects and features, will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing two embodiments of the invention relating to the control of regeneration in vacuum tubes.

45 Referring to Figure 1, there is shown a radio receiving system for receiving signals modulated on a carrier wave impressed on

the system. There are three three-element vacuum tubes which are set up as the oscillator O, the amplifier A and the detector D, respectively. The oscillator O is of the tuned grid type having a tuned grid circuit
55 comprising an inductance 11 and a condenser 12, the inductance 11 which is between the grid and cathode of the oscillator O being inductively coupled to the inductance 13 which is between the anode and a battery 14.
60 The inductance 11 and condenser 12 together form a tuned circuit having negligible reactance at the frequency of the oscillator. The battery 14 is employed for supplying the potential for the anode of the oscillator
65 O. It will be understood, however, that the oscillator O may be of any type well known in the art, preferably any vacuum tube oscillator sustaining oscillations of an inaudible frequency.

70 An amplifier A is coupled to the oscillator O through a potentiometer 15 having a movable arm 16 associated therewith for controlling the potential and, consequently, the amplitude of the voltage of the oscillator O,
75 impressed between the grid and cathode of the amplifier A. A battery 17 is employed for supplying the necessary potential to the anode of the amplifier A through the primary winding of a transformer T. It will
80 be understood, however, that the amplifier A may be of any well-known type, preferably any vacuum tube amplifier. A condenser 18 is bridged across the secondary winding of the transformer T, the secondary winding of
85 the transformer T and the condenser 18 together forming a circuit tuned to the frequency of the oscillator O having negligible reactance at the frequency of the oscillator O.

90 A three-element vacuum tube D having an anode, a cathode and a grid is set up so that an input circuit is connected between its grid and cathode including an inductance 19 and an output circuit is connected between its anode and cathode including an inductance 20. These inductances, 19 and 20, are
95 so arranged that energy in the output circuit is fed back to the input circuit, the coupling between these inductances being fixed. A receiving circuit connected to a receiving
100

antenna RA is also coupled to the inductances 19 and 20 through an inductance 21 included in the receiving circuit. The variable condenser 22 tunes the circuit which includes the secondary winding of the transformer T, the condenser 18, the inductance 19 and the condenser 22 to a frequency different from the frequency to which the secondary winding of the transformer T and the condenser 18 are tuned. A battery 23 supplies the potential for the anode of the detector D through a telephone receiver 24 and the inductance 20. The telephone receiver 24 receives the signals after detection by the detector D, a condenser 25 bridging the telephone receiver 24 for forming a path of low impedance to high frequency waves.

In this invention the oscillator O sustains oscillations of a definite frequency which is used to control the effective resistance in the input circuit of the detector D as well as the magnitude of regeneration in the system. The particular frequency of the oscillations sustained by oscillator O is immaterial. However, as the amplitude of these oscillations increases, the effective resistance in the input circuit of detector D increases and vice versa.

A fixed coupling exists between inductances 19, 20 and 21 which is of the inductive type. It will be understood, however, that any other type of coupling may be used equally well to accomplish the same end. Furthermore, the potential between the grid and cathode of the detector D is varied by the movable arm 16 associated with the potentiometer 15 in order to control the degree of regeneration existing between the output circuit and the input circuit of the detector D, the potentiometer 15 being employed for controlling the magnitude of the voltage of the amplifier A impressed, through the various tuned circuits, between the grid and cathode of the detector D. Thus by cutting more resistance out of the potentiometer 15, the potential between the grid and cathode of the detector D will be decreased, and consequently the degree of regeneration between the output and input circuits of the detector D will also be decreased. On the other hand, by cutting less resistance out of the potentiometer 15, the potential between the grid and cathode of the detector D will be increased, and consequently the degree of regeneration between the output and input circuits of the detector D will also be increased. Furthermore, the control of regeneration does not involve any change in the frequency of the tuned circuits associated with the detector D or in the frequency of the oscillator O, but merely involves an adjustment of the amplitude of the frequency of the oscillator O.

Fig. 2 represents another embodiment of

the invention for controlling regeneration. An oscillator O is set up as described in the patent to R. V. Hartley, No. 1,356,763, dated October 26, 1920, having an inductance 31 in its input circuit, an inductance 32 in its output circuit and a condenser 33 bridging inductances 31 and 32. The inductances 31 and 32 and the condenser 33 together form a circuit tuned to the frequency of the oscillator. An amplifier A_1 is coupled to the oscillator O through a condenser 34 and a potentiometer 35, said potentiometer having a movable arm 36 associated therewith for controlling the amplitude of the frequency of the oscillator O impressed on the amplifier A_1 . A detector D is coupled to the amplifier A_1 through a transformer T_1 , the frequency of the oscillator periodically controlling the negative potential of the grid with respect to the cathode.

The receiving circuit for receiving a high frequency wave modulated by signals comprises the receiving antenna RA and an inductance 37. The inductance 37 is coupled to inductances 38 and 39, the inductance 38 being in the input circuit of the detector D and the inductance 39 being in the output circuit of the detector D. The variable condenser 40 is employed for tuning the circuit coupled to the inductance 37 which includes inductance 38, condenser 41, inductance 39 and the variable condenser 40. Choke coils 42 and 43 are connected in the input and output circuits of the detector D, respectively. A condenser 44 closes a path for high frequency waves in the output circuit of the detector D, which path includes the anode and cathode of the detector D, the inductance 39 and the condenser 44.

The transformer T_2 couples an amplifier A_2 with the output circuit of the detector D in order that the signals detected by the detector D may be further amplified by the amplifier A_2 . A telephone receiver 45 receives the signals detected by the detector D and amplified by the amplifier A_2 , a condenser 46 bridging the telephone receiver 45 and forming a path of low impedance for high frequency currents.

A battery 47 supplies the potential for the anodes of the various vacuum tubes employed in this system, the potential for the anode of the oscillator O being supplied through a conductor 48 and the inductance 32, the potential for the anode of the amplifier A_1 being supplied through the conductor 48 and the primary winding of the transformer T_1 , the potential for the anode of the detector D being supplied through the conductor 48, the primary winding of the transformer T_2 , the choke coil 43 and the inductance 39, and the potential for the anode of the amplifier A_2 being supplied through the telephone receiver 45.

The potential between the grid and

cathode of the detector D is controlled by varying the amplitude of the wave transmitted by the oscillator O by means of the potentiometer 35 having the movable arm 36 associated therewith. By virtue of the coupling between inductances 38 and 39 in the input and output circuits of the detector D, respectively, the degree of regeneration is controlled by the potentiometer 35 associated with the oscillator O.

While the invention has been shown and described in two embodiments which have particular reference to systems for the reception of signals modulated on a high frequency wave, it is to be understood that the invention may be embodied in other and widely varied organizations and various other systems without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. The method of controlling regeneration in a vacuum tube having an input circuit and an output circuit with a fixed coupling therebetween, which consists in impressing a wave of constant frequency on the input circuit of said vacuum tube and varying the amplitude of the impressed wave.

2. The method of receiving signals which consists in impressing a carrier wave modulated by signals on a three-element vacuum tube set up for regeneration and controlling the regeneration by means of another wave of adjustable amplitude.

3. The method of receiving signals with a vacuum tube having an output circuit connected to its anode and cathode and an input circuit connected to its grid and cathode, the energy in the output circuit being fed back to the input circuit due to a fixed coupling therebetween, which consists in impressing a high-frequency wave modulated by signals and another wave of constant frequency on the input circuit, and adjusting the amplitude of said latter wave to control the rate at which the energy is fed back from the output circuit to the input circuit.

4. In a vacuum tube having an anode, a cathode and a grid in which an inductance is connected between the grid and the cathode and another inductance is connected between the anode and the cathode, said inductances being coupled to each other for regeneration, the method of receiving signals which consists in impressing on the inductance connected between the grid and the cathode a wave modulated by signals, impressing another wave of constant frequency on the same inductance, and adjusting the amplitude of said latter wave to control the degree of regeneration.

5. In a signal-receiving system, a vacuum tube having an anode, a cathode and a grid, an input circuit connected to its grid and cathode, an output circuit connected to its

anode and cathode, a fixed coupling existing between said input circuit and said output circuit, an oscillator transmitting a wave of constant frequency which is impressed on said input circuit, and means for varying the amplitude of the latter wave for controlling the regeneration.

6. A signal receiving system comprising a three-element vacuum tube having an input circuit and an output circuit coupled together for regeneration, a wave modulated by signals impressed on the input circuit of said vacuum tube, another wave of constant frequency also impressed on the input circuit of said vacuum tube, and means for controlling the degree of regeneration by varying the amplitude of said latter wave.

7. In a radio receiving system, in combination, a vacuum tube having an anode, a cathode and a grid, an input circuit connected to the grid and cathode, an output circuit connected to the anode and cathode, a fixed coupling between the input circuit and the output circuit for feeding energy in the output circuit back to the input circuit, a high-frequency wave modulated by signals impressed on the input circuit, another wave of constant frequency also impressed on the input circuit, and means for adjusting the amplitude of the latter wave to control the rate at which energy is fed from the output circuit back to the input circuit.

8. A radio receiving system comprising a vacuum tube having an anode, a cathode and a grid, an inductance connected between the grid and the cathode, another inductance connected between the anode and the cathode, said inductances being coupled together for regeneration, a wave modulated by signals impressed on the inductance connected to the grid and the cathode, another wave of constant frequency also impressed on the inductance connected to the grid and the cathode, and means for adjusting the amplitude of the latter wave to control the degree of regeneration.

9. In a radio receiving system, an oscillator of constant frequency, a three-element vacuum tube having an anode, a cathode and a grid, a receiving circuit for receiving a high-frequency wave modulated by low frequency signals, three inductances, one inductance being connected between the anode and the cathode of the three-electrode vacuum tube, a second inductance being connected between the grid and the cathode of the three-electrode vacuum tube, and a third inductance being included in the receiving circuit, said inductances bearing a fixed coupling therebetween, an oscillator transmitting a wave which is impressed on the inductance connected between the grid and the cathode of the three-element vacuum tube, and a potentiometer, said potentiometer

ter being associated with said oscillator for adjusting the amplitude of the wave transmitted thereby and controlling the magnitude of regeneration.

5 10. In a radio receiving system, an oscillator of constant frequency, an amplifier for amplifying oscillations of said oscillator, a potentiometer for controlling the gain of said amplifier, a three-element vacuum tube having an anode, a cathode and a grid, an input circuit connected between the grid and the cathode of said three-element vacuum tube, an output circuit connected between the anode and the cathode of said 15 three-element vacuum tube, and a receiving circuit for receiving high-frequency oscillations modulated by low-frequency signals, said input circuit, said output circuit and said receiving circuit being invariably coupled together.

20 11. In a signaling system, in combination, a high-frequency oscillator, a receiving circuit for receiving another high frequency modulated by signals, a three-electrode vacuum tube having an input circuit including the grid and the cathode of said vacuum tube and an output circuit including the anode and the cathode of said vacuum tube, a pair of inductances one in said input circuit and the other in said output circuit, 30 said inductances having a fixed coupling therebetween for feeding energy in said output circuit back into said input circuit, and a potentiometer for controlling the potential of the current transmitted by said high-frequency oscillator to the input circuit of said vacuum tube.

35 In testimony whereof, I have signed my name to this specification this 18th day of February 1926.

RUSSELL S. OHL.

45

50

55

60

65