

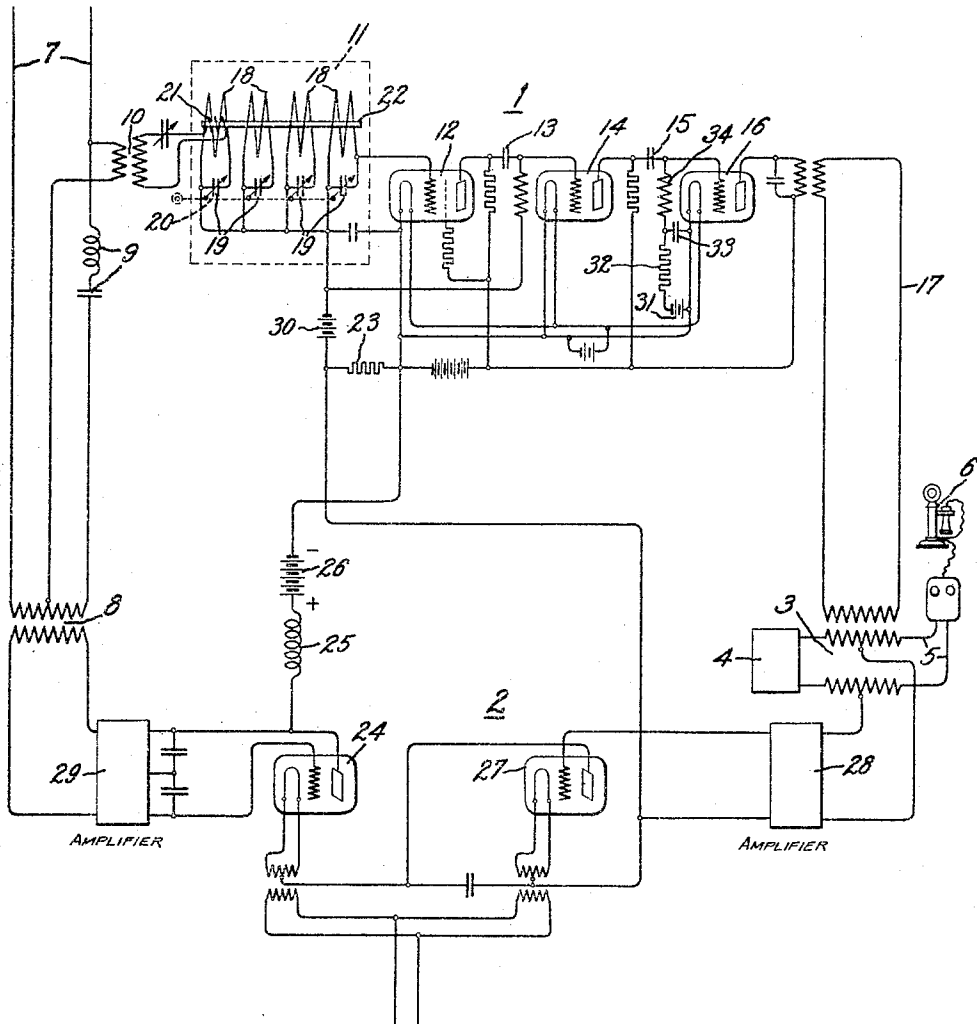
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SIGNALING SYSTEM

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## UNITED STATES PATENT OFFICE

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## SIGNALING SYSTEM

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My invention relates to high frequency signaling systems, and more particularly to duplex communication systems in which signaling is effected in different directions on the same carrier wave frequency.

One of the objects of the invention is to provide a signaling system of the type indicated having improved means for protecting the receiving equipment from oscillations produced by the associated transmitter.

A further object of the invention is to provide a receiving system having a simple circuit arrangement and which is nevertheless highly selective to desired frequencies, which includes means for automatically controlling the volume of signal produced in the output circuit of the system and which also includes means for protecting the receiving equipment from oscillations produced at the transmitter.

A further object of the invention is to provide novel and improved means whereby the volume of output signal may be automatically controlled.

Still a further object of the invention is to provide a novel and improved means for efficiently protecting the receiving system against oscillations produced by the transmitter without producing undesirable clicks and noises in the operator's receiving instrument or head-phone.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which the single figure represents an embodiment of my invention.

Referring to the drawing I have shown a single frequency duplex communication system which may be adapted for operation over the lines of a power distribution system, or through space, as by radio, as desired. The system comprises a receiving circuit 1 and a transmitting circuit 2, the output from the receiving circuit and the input

to the transmitting circuit being coupled together and to a telephone line 5 by means of a suitable balanced, or bridge arrangement such as a hybrid coil 3. An impedance network 4 is provided to balance the impedance of the line 5 through the hybrid coil 3 in a manner well known in the art. By means of the hybrid coil 3 energy from the output of the receiver is prevented, in a well-known manner, from entering the input to the transmitting system. The input to the receiving circuit and the output from the transmitting circuit are likewise connected to the outgoing channel 7 through the balance arrangement comprising the secondary winding of the output transformer 8, the impedance network 9 and primary winding of input transformer 10. The channel 7 may extend through a coupling system to the lines of a power distribution system, or if desired, to a suitable antenna arrangement.

The receiving circuit of the system comprises a band-pass filter 11 which is connected between the secondary winding of the input transformer 10 and the grid of a radio frequency amplifier 12. The radio frequency output from the amplifier 12 is supplied through a coupling condenser 13 to the grid of a second radio frequency amplifier 14 and thence through coupling condenser 15 to the grid of a detector 16. The received high frequency current is demodulated in this detector and supplied through the link circuit 17 and hybrid coil 3 to the telephone circuit 5 and thence to the remote operator's telephone instrument 6.

The transmitting system comprises an automatically controlled electron discharge oscillation generator 24 from which oscillations are supplied through an amplifier 29 to the output transformer 8 and thence to the transmitting channel. The operation of the discharge device 24 is controlled by discharge device 27 which is included in its plate circuit. This circuit extends from the anode of device 24 through radio frequency choke coil 25, source of potential 26, resistance 23 and cathode and anode of device 27 to the cathode of device 24. The impedance of device 27 is normally sufficiently high to

preclude the flow of anode current and thereby prevent the oscillation generator from operating. When the operator speaks into the microphone of the instrument 6, signal currents are supplied through hybrid coil 3, and  
5 amplifier 28 to the grid of device 27. The impedance of this device is thus sufficiently reduced to permit anode current to flow and thereby cause operation of generator 24. Oscillations produced by generator 24 may be  
10 modulated by voice waves by any suitable means not shown. This modulating means may, for example, be of the type shown in Patent No. 1,696,590, Lester F. Bird issued  
15 December 25, 1928.

The filter 11 comprises a plurality of loosely coupled coils 18 each of which is tuned by a separate variable condenser 19. The movable plates of these condensers are  
20 mounted upon a common shaft and controlled by means of a single knob as indicated by the dotted line 20. The coils 18 may be adjustably mounted upon a common support 22 and spaced apart as desired to provide  
25 the desired operating characteristics of the filter. The input circuit of the filter comprises a coil 21, which preferably is of smaller diameter than the first coil 18 and which is mounted concentrically therewith to provide relatively close inductive relation. This  
30 coil is connected in a tuned link circuit including the secondary winding of transformer 10. It will be noticed that the individual tuned circuits comprising the coils 18 and their associated condensers are not connected  
35 in circuit relation with each other, and that the transfer of energy through the filter takes place entirely by virtue of the inductive coupling and such capacitive coupling as exists between the coils by virtue of their  
40 spaced relation. It has been found that a filter of the type indicated may be made to have the characteristic of passing a very narrow band of frequencies to the exclusion of  
45 others, and that the frequency attenuation characteristic of the filter may be made to have very steep sides such that the band of frequency which is efficiently passed by the filter is sharply marked from those frequencies  
50 which are excluded.

It will be noticed that the entire selectivity of the receiving system is dependent upon the characteristics of the filter 11, this filter being connected in the circuit previous to the  
55 first stage of amplification, and the different amplifiers being otherwise untuned.

This arrangement is particularly advantageous where the system is employed upon a communication channel upon which other  
60 stations operate on carrier waves which differ in frequency only slightly from the frequency at which the system 1, 2, operates. As thus employed it may occur that carrier waves emanating from other stations may be of very  
65 strong intensity whereas waves emanating

from stations with which communication is desired may be very weak. Accordingly were these undesired strong waves permitted to reach the amplifiers of the receiving circuit 1 these amplifiers are likely to be blocked  
70 thereby preventing their proper amplification of desired signals of less intensity. This difficulty may be very satisfactorily avoided by use of the highly selective filter 11 prior to the first stage of amplification.  
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The device 12 is of the screen-grid electron discharge type such that its input impedance is high. This high input impedance prevents the discharge device 12 from having any substantial detuning effect upon the circuit of  
80 the last coil 18 of the filter. Thus all of the condensers 19 may be controlled by a single control knob and equally affect the tuning of the associated coil.

Various means have heretofore been provided for protecting the receiving circuit of a duplex communication system from the strong oscillations produced by the associated transmitter, a well known form being that in which an electron discharge device is connected in shunt with the receiving circuit and having its impedance controlled either by the intensity of the received signals or by operation of the transmitter. In a system in which desired signals are sufficiently attenuated to necessitate the use of amplifiers, certain advantages may be had in the simplicity of the system by employing these same  
85 amplifiers for rendering the receiving systems unresponsive to oscillations produced by the associated transmitter. This is accomplished, in the system disclosed, by connecting a resistance 23 which is included in the anode circuit of oscillation generator 24 between the grid and cathode of the amplifiers  
90 12 and 14 such that the potential on the grids of the amplifiers is controlled by operation of the transmitting system.  
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The amplifiers 12 and 14 are normally biased by the source of potential 30 to a point  
100 such that they operate upon the straight portion of their anode current-grid voltage characteristic. When the operator speaks into his microphone, however, and the oscillation generator is thereby set into operation, current  
105 flowing in the resistance 23 causes the bias potential to be overcome and a positive potential to be supplied to the discharge devices 12 and 14 sufficient to render these devices insensitive to received oscillations. In this  
110 way the receiving equipment is protected from the high intensity oscillations of the transmitter and any tendency of the system to sing due to energy from the circuit 17 entering the transmitting circuit is avoided.  
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It will be noted that the amplifier 14 is of the three-element type, whereas the amplifier 12 is of the four-element or screen-grid type. As above explained, the use of the screen-grid device 12 prevents any detuning  
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effect of the electron discharge device upon the last circuit of the filter. To obtain the desired degree of protection, however, it is desirable that the device 14 be of the three-element type since its operating characteristic may be more readily controlled by means of the potential upon the resistance 23.

It will of course be understood that the potential on the grids of devices 12 and 14 may be driven either in a positive or negative direction by means of resistance 23 thereby to render the receiving system insensitive to received signals. As shown in the drawing, however, this resistance is so connected that the grids are driven in a positive direction by means of resistance 23 sufficiently to render these devices unresponsive to received signals. It has been found, through experiments, that by driving the grids positive the receiving system may be rendered inoperative in response to operation of the transmitter without producing any annoying clicks and noises in the receiving instrument, whereas it has been found that such noises occur when the grid potential is varied in a negative direction by resistance 23.

In order that the intensity of the output signals may be controlled without materially increasing the complication of the system, the grid circuit of the detector is provided in addition to the usual biasing source 31, with an additional resistance 32 of high value, and a condenser 33. A choke coil 34 is included in the connection from the resistance 32 and condenser 33 to the grid to prevent a low impedance external path for high frequency oscillations between the grid and cathode of the electron discharge device. The source of biasing potential 31 is such that the device 16 operates upon the lower curved portion of its characteristic curve and, hence, serves to demodulate the received carrier wave and reproduce in its output circuit the audio frequency signal currents which are impressed thereon. Thus the detector 16 is of the ordinary biased type having, in addition, a resistance 32 and condenser 33 associated with the grid circuit as indicated. The effect of the resistance 32 is to increase the bias potential when grid current starts to flow in the detector, and its value may be so adjusted that after grid current starts to flow in the detector the volume of the audio signal may be prevented from decreasing, as is the case in the operation of the usual biased detector. In fact, this resistance may be so adjusted that the audio output from the detector may be maintained at a substantially constant value notwithstanding further increases in the intensity of the impressed carrier wave after grid current has started to flow. When the intensity of the impressed carrier wave is such that no grid current flows the resistance in the grid has no effect

and the operation of the device is that of the normal grid-biased detector. In addition to the above advantage, it has been found that the quality of the signal is considerably improved in that range of intensity of the received carrier waves in which the resistance 32 is effective over the quality which is had in this range were the resistance 32 omitted.

It is desirable that the volume control device of the receiver should respond only to the average intensity of the received carrier wave, or to the energy level thereof, and not to rapid variations therein such as are produced by voice or signal modulation. It is desirable, however, that it should respond to fairly rapid variations in the carrier energy level: Thus in single frequency duplex carrier communication systems in which the generation of the carrier wave is controlled by voice and is, hence, interrupted between words, it may occur that the energy level during successive words is different. The volume control device should thus be sufficiently rapid in its operation to respond to these variations in carrier energy level but at the same time should not be sufficiently rapid to respond to voice modulations. For this reason a condenser 33 of fairly large capacity is connected between the cathode of device 16 and the grid. The value of this capacity is such as to cause this condenser to smooth out the grid bias potential and to retard the action of resistance 32 sufficiently to give the desired rapidity of operation.

While I have shown a particular embodiment of my invention it will of course be understood that I do not wish to be limited thereto, since many modifications both in the circuit arrangement and in the instrumentalities employed may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination, in a high frequency signaling system of a receiving circuit including a plurality of stages of radio frequency amplification, a multiple unit filter connected in the input of the first of said stages, means for simultaneously tuning all of said units of said filter, said first stage having sufficiently high input impedance to prevent substantial detuning effect upon said filter, a transmitting system, and means responsive to operation of the transmitting system for controlling another of said stages thereby to render said receiving system insensitive to oscillations transmitted from said transmitting system.

2. In combination, a receiving circuit including a multiple unit filter, an electron discharge device having its input connected to

receive signals from said circuit through said filter, means for controlling the operation of said electron discharge device, said means being effective in its operation to vary the input impedance of said discharge device, means interposed in said circuit between said filter and said discharge device to prevent variations in said input impedance from affecting said filter, and a common means for varying a plurality of units of said filter.

3. The combination, in a high frequency signaling system of a receiving circuit including a uni-control tuned multiple unit filter, an electron discharge amplifier device having its input connected to receive signals through said filter, means interposed between said multiple unit filter and said amplifier device to prevent substantial detuning effect upon said filter, a transmitting circuit, and means responsive to the operation of said transmitting system for controlling said amplifier device thereby to render said re-

ceiving system insensitive to oscillations transmitted from said transmitting system.

4. The combination in a high frequency signaling system of a transmitting circuit, a receiving circuit associated therewith including a uni-controlled tuned multiple unit filter, a plurality of untuned stages of radio frequency amplification, each of said stages having an electron discharge device including a cathode and a control element, said first stage having sufficiently high input impedance to prevent substantial detuning effect upon said filter, and means responsive to the operation of said transmitting circuit to impress a high positive potential on said control electrode with respect to said cathode and thereby render said receiving circuit insensitive to received oscillations.

In witness whereof, I have hereunto set my hand this 17th day of March, 1930.

FRANK M. RIVES.

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