

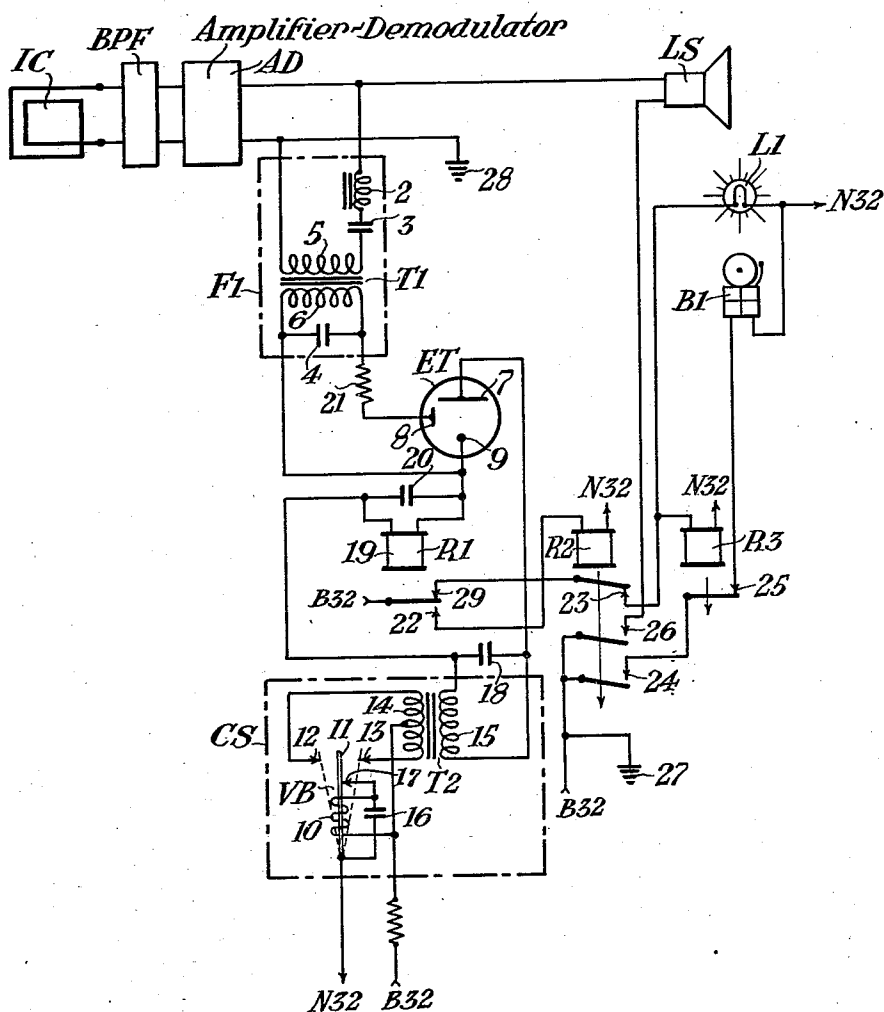
March 24, 1942.

L. D. WHITELOCK

2,277,469

RECEIVING APPARATUS FOR TRAIN COMMUNICATION SYSTEMS

Filed Dec. 31, 1940



INVENTOR
Leland D. Whitelock.
BY *[Signature]*
HIS ATTORNEY

UNITED STATES PATENT OFFICE

2,277,469

RECEIVING APPARATUS FOR TRAIN
COMMUNICATION SYSTEMS

Leland D. Whitelock, Wilkinsburg, Pa., assignor to
The Union Switch & Signal Company, Swiss-
vale, Pa., a corporation of Pennsylvania

Application December 31, 1940, Serial No. 372,475

6 Claims. (Cl. 179—82)

My invention relates to receiving apparatus for train communication systems.

Railway train communication systems ordinarily use a carrier current. A carrier current of a preselected frequency is modulated by the voice frequency produced by speaking into a telephone transmitter for telephone communication. Preferably a preselected side band of such modulated current is transmitted, the carrier and the other side band being suppressed. In such a system a calling or signaling current equivalent to the carrier modulated by a preselected frequency within the voice frequency range is employed for calling and signaling. The receiving apparatus includes a demodulator operable to demodulate and pass only the voice frequency energy to a telephone receiver or loud speaker at which device speech is reproduced in response to reception of such telephone current. When the calling or signaling current is received then energy of the single preselected frequency appears in the output of the demodulator and this calling current is used to govern a suitable signaling or calling device, such as a lamp or electric bell. The loud speaker may be normally held at an inactive condition and switched to an active condition upon reception of the calling current. Again the calling or signaling current may be transmitted continuously except during periods when telephone communication is desired in order to provide a continuous check on the operative condition of the apparatus and under such circumstances an indication lamp is normally energized to indicate the operative condition of the apparatus. In this latter case the loud-speaker is held at an inactive condition as long as the signaling current is received and is switched to an active condition when such signaling current ceases.

Accordingly a feature of my invention is the provision of receiving apparatus for railway train communication systems incorporating novel and improved means responsive to a signaling current for controlling signaling devices according to the presence or absence of such signaling current.

Another feature of my invention is the provision of receiving apparatus for railway train communication systems incorporating novel means for controlling a first indicator to display to the operator in attendance at such receiving apparatus a steady indication as long as signaling current is received and to display a different indicator upon the termination of such signaling current as an indication to the operator that telephone communication is desired.

Again a feature of my invention is the provision of novel means for receiving apparatus for train communication systems wherewith the loud speaker is automatically coupled to the demodulator when the calling or signaling current ceases.

Another feature of my invention is the provision in receiving apparatus for train communication systems of effective and inexpensive calling and signaling means.

The above cited features of my invention as well as other advantages which will be apparent from the following specification, are attained according to my invention by providing an ionization type of electron tube, a source of alternating current and slow acting relays which are themselves controlled by the electron tube and which relays in turn control a signal lamp and a signal bell and automatically switch a loud speaker from an inactive to an active condition according as signaling current is or is not received. A filter tuned to pass energy of a frequency corresponding to that of the calling or signaling current is connected across the output terminals of the demodulator included in such receiving apparatus. The source of alternating current and a control relay are included in an anode circuit of the electron tube to energize the relay when the tube is ionized. The output terminals of the filter are included in the control circuit of the tube and the tube is caused to ionize by the energy passed by the filter when signaling current is received. The anode circuit relay controls the slow acting relays in such a manner as to cause the lamp to be illuminated as long as the anode circuit relay is energized and picked up. When the signaling current ceases the electron tube deionizes due to the alternating voltage of the source included in the anode circuit and the anode circuit relay is deenergized and released to effect a control of the slow acting relays, such control being effective to cause the lamp to be extinguished and an electric bell to sound during the slow acting period of at least one slow acting relay. The slow acting relays when thus controlled are also effective to couple the loud speaker to the output terminals of the demodulator. Hence the signaling current when continuously received causes the display of the indication lamp as an indication that the system is operative and when such signaling current ceases the bell is sounded to indicate to the attendant at the receiving apparatus that telephone communication can be expected and the loud speaker is effectively coupled to the output of the demodulator.

I shall describe one form of apparatus embodying my invention and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing a preferred form of apparatus embodying my invention.

Referring to the drawing the reference character IC designates an inductor mounted on a vehicle of a railway train in inductive relation to a transmitter circuit, not shown. The induc-

tor IC is preferably mounted in inductive relation to the track rails, the track rails being included in a transmitting circuit to which communication current is supplied at some station remote from the vehicle on which the inductor IC is mounted. This transmitting circuit for transmitting communication current between two spaced stations along the railway may be that covered by Letters Patent of the United States No. 2,112,364, granted March 29, 1938, to L. O. Grondahl for Electric train signaling systems.

The electromotive forces induced in inductor IC in response to current flowing in the associated transmitting system are applied to the input side of a filter BPF, the output side of which is connected across the input terminals of an amplifier demodulator AD. The filter BPF is of the usual band pass type and is proportioned to pass the frequency band of the communication current used and to substantially suppress frequencies either above or below such frequency band. For example, it has been proposed for communication systems for railway trains to employ the upper side band of a carrier current of 6,000 cycles per second modulated by voice frequencies for telephone communication and to use the equivalent of such carrier current modulated by a single preselected frequency within the voice frequency range for calling and signaling. Under such circumstances the filter BPF would pass a band extending from 6,500 to 8,500 cycles per second, the voice frequency range being taken as extending from 500 cycles to 2,500 cycles. For signaling the current transmitted may be of 7,000 cycles per second which is the equivalent of the upper side band of the carrier of 6,000 cycles modulated by the voice frequency of 1,000 cycles.

The amplifier demodulator AD may be any one of several well-known types for such devices and is shown conventionally for the sake of simplicity. It is sufficient for the present application to point out that the amplifier-demodulator AD includes a normally active source of carrier current for mixing with the incoming communication current, and is operative to cause only the voice frequencies to appear in the output of the demodulator, the local carrier and the other products of demodulation being suppressed. One or more stages of amplification may be employed either ahead of demodulation or after demodulation or amplification may be used both ahead of and after demodulation. On the assumption the communication current is of the frequency range referred to above then energy of the voice frequency band extending from 500 to 2,500 cycles appears at the output terminals of the amplifier-demodulator AD when telephone current is picked up by inductor IC, and energy of the single preselected frequency of 1,000 cycles appears at the output terminals of the amplifier-demodulator when signaling current is picked up by inductor IC. It will be understood of course that my invention is not limited to the frequencies set forth hereinbefore but such frequencies are used for illustration only.

A filter F₁ including a reactor 2, a transformer T₁ and condensers 3 and 4 is connected across the output terminals of the amplifier-demodulator AD, the arrangement being that primary winding 5 of transformer T₁, condenser 3 and reactor 2 are connected in series across the output terminals of the amplifier-demodulator, and condenser 4 is connected across secondary winding 6 of transformer T₁. The parts of filter F₁ are proportioned to pass only energy of the frequency

of the signaling current, that is, to pass only energy of 1,000 cycles per second when the signaling current is of a frequency assumed hereinbefore.

The apparatus includes an electron tube ET, a source of alternating current CS and a control relay R₁. The tube ET is preferably of the cold cathode gas filled type and is provided with an anode 7, a control element 8 and a cathode 9. The current source may be any suitable source of alternating current and is shown as comprising a vibrator VB and a transformer T₂. An operating winding 10 of vibrator VB is connected over its own contact 17 to a suitable source of direct current such as the usual train carried 32 volt generator or battery, not shown, but whose terminals are indicated at B32 and N32, and armature 11 of vibrator VB is caused to vibrate at a frequency preselected according to the proportioning and adjustment of the parts of the vibrator. Armature 11 when vibrated alternately engages contacts 12 and 13 and causes current from the direct current source to be supplied to two portions of primary winding 14 of transformer T₂ with the result that an alternating electromotive force is induced in secondary winding 15 of transformer T₂. The parts are so proportioned that the electromotive force induced in secondary winding 15 is of, say, 110 volts and of a frequency of, say, 60 cycles per second although such voltage and frequency are not essential and some other voltage and frequency may be selected if desired. A condenser 16 is connected across the contact 17 of vibrator VB to suppress sparking at the contact and a condenser 18 is connected across secondary winding 15 to improve the operation.

Electron tube ET is provided with an anode circuit which includes lower terminal of secondary winding 15 of transformer T₂, anode 7 and intervening tube space to cathode 9 of tube ET, winding 19 of relay R₁ and a condenser 20 in parallel and thence to the upper terminal of secondary winding 15. Relay R₁ is a direct current relay of the usual acting type. A control circuit for tube ET includes secondary winding 6 of transformer T₁ connected across control element 8 and cathode 9 of tube ET, a resistor 21 being preferably interposed in the connection. When no electromotive force is applied to control element 8 of tube ET the voltage applied across anode 7 and cathode 9 from secondary winding 15 of transformer T₂ fails to ionize the tube and no current flows and relay R₁ is deenergized and released. When a sufficient voltage is applied to control element 8 to drive control element 8 positive in potential with respect to cathode 9, ionization is effected for tube ET and current flows in the anode circuit. The parts are so proportioned that when signaling current is received and energy passed by filter F₁, the positive half cycle of such energy drives control element 8 positive in potential with respect to cathode 9 and tube ET is ionized, and since the signaling current energy passed from filter F₁ is of the frequency of 1,000 cycles per second and each positive half cycle of such energy is effective to control element 8 positive in potential with respect to cathode 9, rectified current flows in the anode circuit of tube ET and relay R₁ is effectively energized and picked up, the condenser 20 connected in multiple with winding 19 of relay R₁ serving to smooth out the rectified current. When there is either no voltage or a relatively

low voltage applied to control element 8, the tube ET deionizes during the negative half cycles of the alternating current supplied to the anode circuit and relay R1 is deenergized and released. When telephone current is received, the voice frequency of 1,000 cycles will at times appear and produce momentarily energy which is passed by filter F1 and which energy when applied to control element 8 of tube ET may effect ionization with the result that relay R1 may be momentarily picked up but such momentary operation of relay R1 will not be effective to change the control effected by relay R1 over a slow acting relay as will be shortly described.

The apparatus also includes two slow release relays R2 and R3, a signal lamp L1, a signal bell B1 and a loud speaker LS. Relay R2 is energized over an obvious circuit including back contact 22 of relay R1 and relay R3 and lamp L1 are controlled in parallel over an obvious circuit including front contact 29 of relay R1 and back contact 23 of relay R2. Bell B1 is controlled over a circuit including terminal B32, front contact 24 of relay R2, front contact 25 of relay R3, winding of bell B1 and terminal N32. The circuit for the loud speaker LS can be traced from the upper right hand output terminal of amplifier-demodulator AD over the operating winding of loud speaker LS, front contact 26 of relay R2, ground electrodes 27 and 28 and to the lower right-hand output terminal of the amplifier-demodulator.

It is clear that when signaling current is received and relay R1 is picked up, due to the ionization of tube ET, relay R2 is released and relay R3 is picked up and lamp L1 is illuminated, the illumination of lamp L1 being an indication to the attendant at the receiving apparatus that signaling current is being received and that the system is in an operative condition. The loud speaker is now disconnected from the output terminals of the demodulator and is inactive. When reception of such signal current ceases and relay R1 is released, relay R2 is at once picked up over back contact 22 of relay R1 and relay R2 on picking up opens back contact 23 and closes front contacts 26 and 24. The lamp L1 is extinguished as soon as relay R1 is released to open front contact 29 and its circuit is then held open at back contact 23 of relay R2 when relay R2 is picked up. Relay R3 is also deenergized when relay R1 is released but relay R3 does not release until the end of its slow release period, and during the slow release period of relay R3 the bell B1 is supplied with current to provide an audible indication to the attendant of the receiving apparatus that signaling current has ceased and that telephone communication may be expected. With the closing of front contact 26 of relay R2, the loud speaker LS is effectively connected to the output of the amplifier-demodulator and conditioned for reproduction of the voice frequencies of the telephone current. In the event the voice frequency of 1,000 cycles appears in the telephone current so that energy is passed by filter F1 to the control circuit of tube ET, the tube ET may be caused to ionize with the result that relay R1 is picked up. Such voice frequency will persist in the telephone current only for a relatively short interval and hence relay R1 will be picked up for only a short interval so that relay R2 which is controlled over back contact 22 of relay R1 will not release due to its slow release characteristic during the short interval that relay R1 may be picked up when

telephone current is received. When the telephone current ceases and signaling current is again transmitted causing relay R1 to be picked up for an extended period of time, then relay R2 is deenergized and released at the end of its slow release period causing lamp L1 to be illuminated, relay R3 to be picked up and the loud speaker LS to be disconnected from the amplifier-demodulator with the net result that the apparatus is restored to its normal condition, that is to the condition shown in the drawing.

It is to be noted that relay R3 and lamp L1 are controlled over a circuit that includes a front contact 29 of relay R1 and a back contact 23 of relay R2 and a failure of relay R2 will not cause a false display of lamp L1 and false energization of relay R3. It is also to be noted that a normal bias voltage may be readily provided for control element 8 of tube T1 by including a battery or other source of voltage in the control circuit of the tube. Also if it seems desirable to provide means for changing the sensitivity of the discharge tube ET such adjustment can be made by placing a voltage divider across the output of the source of alternating current and connecting the movable contact member of such voltage divider to the anode 7 of the tube. Such voltage divider would also provide a bias voltage for the control element 8 of the tube.

It is to be seen therefore that I have provided simple and inexpensive receiving apparatus for railway train communication systems wherewith a first signal indication is continuously displayed in response to reception of a signaling current to indicate an active condition of the apparatus and a second and different signal indication is displayed for a short period of time when such signaling current ceases to indicate to the attendant at the receiving apparatus that he may expect telephone communication. Also the loud speaker is automatically switched from an inactive to an active condition when signaling current ceases and is then restored to its inactive condition when signaling current is again transmitted.

Although I have herein shown and described but one form of receiving apparatus for train communication systems embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a signaling current which is the equivalent of a carrier current modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a relay, an anode circuit including said alternating current source and said relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the control element and cathode of said tube to cause ionization of the tube by the energy passed by said filter, a signal lamp controlled by a front contact of said relay to indicate reception of said signaling current, an electric bell, and circuit means including a contact of said relay and a slow act-

ing device to cause energization of said bell for a predetermined period when the relay is released upon termination of the signaling current.

2. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a signaling current which is the equivalent of a carrier current modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a control relay, an anode circuit including said alternating current source and said control relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the control element and cathode of said tube to cause ionization of the tube by the energy passed by said filter, a first and a second slow release relay, a signal lamp, an electric bell, means including a back contact of said control relay to energize said first slow release relay, means including a back contact of said first slow release relay to energize said second slow release relay and said signal lamp in parallel, and means including in series a front contact of said first slow release relay and a front contact of said second slow release relay to energize said electric bell.

3. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a signaling current which is the equivalent of a carrier current modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a control relay, an anode circuit including said alternating current source and said control relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the control element and cathode of said tube to cause ionization of the tube by the energy passed by said filter, a first and a second slow release relay, a signal lamp, an electric bell, a circuit including a back contact of said control relay to energize said first slow release relay, a circuit including in series a front contact of said control relay and a back contact of said first slow release relay to energize said signal lamp and said second slow release relay in parallel, and a circuit including in series a front contact of said first slow release relay and a front contact of said second slow release relay to energize said bell.

4. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a carrier telephone current and a signaling current equivalent to such carrier modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a relay, an anode circuit including said alternating current source and said relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the

control element and cathode of the tube to cause ionization of the tube by the energy passed by said filter, a signal controlled over a front contact of said relay to indicate reception of said signaling current, a loud speaker, and means controlled over a back contact of said relay to effectively couple said loud speaker to the output terminals of said demodulator for reproduction of speech upon reception of said telephone current.

5. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a carrier telephone current and a signaling current equivalent to such carrier modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a relay, an anode circuit including said alternating current source and said relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the control element and cathode of the tube to cause ionization of the tube by the energy passed by said filter, a signal lamp controlled over a front contact of said relay to indicate reception of said signaling current, a loud speaker, means controlled over a back contact of said relay to effectively couple said loud speaker to the output terminals of said demodulator for reproduction of speech upon reception of said telephone current, an electric bell, and a slow acting means controlled over contacts of said relay to energize said bell for the slow acting period of said slow acting means when the relay is released upon termination of the signaling current.

6. Receiving apparatus for a train communication system comprising, a demodulator capable of demodulating a carrier telephone current and a signaling current equivalent to such carrier modulated by a preselected frequency, a filter having its input terminals connected to the output terminals of said demodulator and tuned to pass energy of said preselected frequency only, an ionization type of electron tube, a source of alternating current, a control relay, an anode circuit including said alternating current source and said control relay connected across the anode and cathode of said tube to energize the relay when the tube is ionized, a control circuit including the output terminals of said filter connected across the control element and cathode of the tube to cause ionization of the tube by the energy passed by said filter, a first slow release relay energized over a back contact of said control relay, a second slow release relay energized over a back contact of said first slow release relay, a signal lamp energized over a back contact of said first slow release relay to indicate reception of said signal current, an electric bell energized over a front contact of each of said first and second slow release relays in series to sound a warning for the slow release period of said second slow release relay when said signaling current ceases, and a loud speaker effectively connected to the output terminal of said demodulator over a front contact of said first slow release relay to reproduce the speech when telephone current is received.

LELAND D. WHITELOCK.