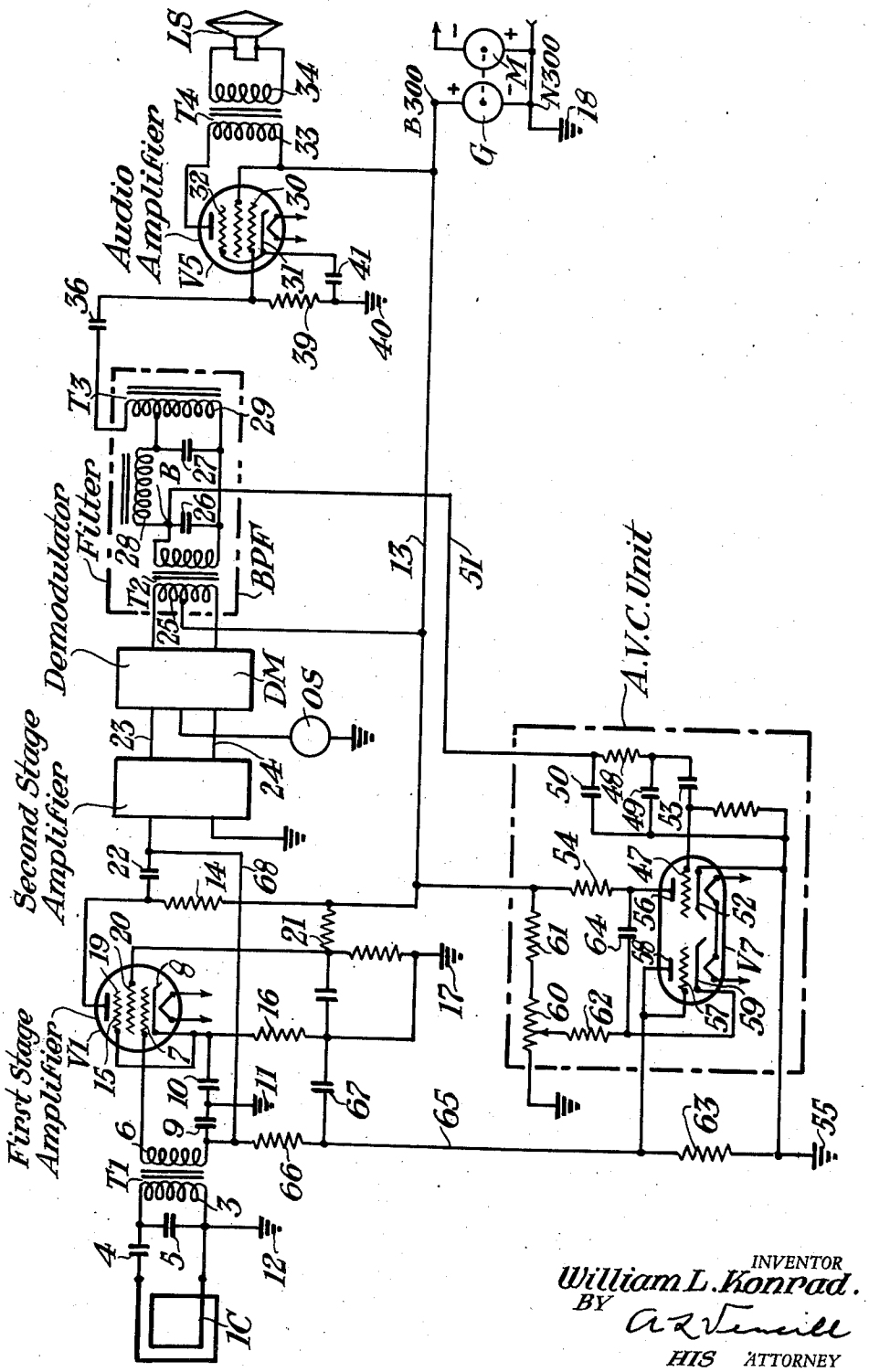
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APPARATUS FOR COMMUNICATION SYSTEMS

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APPARATUS FOR COMMUNICATION SYSTEMS

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1 Claim. (Cl. 250—20)

My invention relates to apparatus for communication systems, and more particularly to receiving apparatus for railway train telephone systems.

This application is a division of my copending application Serial No. 480,645, filed March 26, 1943 for Apparatus for communication systems.

Train telephone systems using the traffic rails in the transmitting channel require an electrical amplifier of relatively high gain between the train carried receiving inductor and the train carried signaling device such as, for example, a loud speaker. Preferably, the receiving apparatus of such a train communication system remains normally in the circuit ready to receive a message. This normal receiving condition results in amplification of minute earth currents, stray magnetic fields and similar random energy during non-communication periods and noise may occur at the loud speaker. Also during communication periods amplification of the noise energy may impair the intelligibility of incoming messages. Furthermore, the energy level of the communication current at the receiving station may vary greatly due to the changing conditions of the transmitting channel through the rails and the changing distances between the station on a moving train and the remote station with which communication is being held, and as a consequence of such variations of the energy level, an adjustment of the receiving apparatus is required if uniform level of reproduction at the loud speaker is to be obtained.

Accordingly, an object of my invention is the provision of communication receiving apparatus incorporating improved automatic volume control means.

Other objects, features and advantages of my invention will appear as the specification progresses.

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

According to my invention, I provide an automatic volume control means which preferably includes a twin triode electron tube. A voltage due to the communication current is taken from a preselected point in the receiving apparatus and fed through a resistance-capacitance filter to the control grid of one section of the twin triode tube to amplify such voltage. The other section of the twin triode tube is arranged as a rectifier to whose cathode a bias voltage is applied. The output of the amplifying section of the tube is fed to the rectifying section which becomes conductive when the amplified voltage overcomes the bias voltage. The energy thus rectified is applied to one or more of the earlier stage tubes of the receiving apparatus as a negative bias voltage to control the amplification gain. A unit consisting of a condenser and a resistor is included in the circuit of the automatic volume control means to form a time delay device which maintains the control voltage between syllables and words of the received communication current.

For a better understanding of the invention, reference may be had to the accompanying drawing which is a diagrammatic view showing one form of apparatus embodying my invention when used with receiving apparatus for a railway train communication system using a suppressed carrier single side band telephone current. It is to be understood, however, that the invention is not limited to railway train communication systems and this one application serves to illustrate the many places where such apparatus is useful.

Referring to the drawing, the receiving apparatus includes a receiving inductor, two stages of intermediate frequency amplification, a demodulator, a filter, one stage of audio frequency amplification and a loud speaker. The reference character IC indicates a receiving inductor for picking up energy due to current sent out from a remote station, not shown. In railway train communication systems of the type referred to hereinbefore, the receiving inductor IC would be mounted on a train in inductive relation to the rails, the rails being included in a transmitting circuit to which current is supplied at the remote station.

The first stage of amplification includes an electron tube V1 which may be any one of the several well-known types and is shown as an indirectly heated pentode whose filament is constantly heated in the usual manner. Receiving inductor IC is coupled to the control grid circuit of tube V1 through a transformer T1. Specifically, inductor IC is connected to primary winding 3 of transformer T1 through a condenser 4, a condenser 5 is connected across primary winding 3, and secondary winding 6 of transformer T1 is connected across control grid 7 and cathode 8 of tube V1 through two condensers 9 and 10 in series. Preferably, the junction terminal of condensers 9 and 10 is connected to a ground electrode 11 and one terminal of primary winding 3 of transformer T1 is con-

nected to a ground electrode 12. Direct current of proper voltage for the plate circuit of tube V1, as well as for other electron tubes of the apparatus to be referred to later, is supplied from a generator G. When the receiving apparatus is mounted on a train, generator G may be driven by a motor M energized from the usual train lighting source. The plate circuit for tube V1 can be traced from positive terminal B300 of generator G through wire 13, resistor 14, plate 15 and intervening tube space to cathode 8 of tube V1, resistor 16 and ground electrodes 17 and 18 to negative terminal N300 of generator G. A first auxiliary grid 19 of tube V1 is connected to cathode 8 and the other auxiliary grid 20 of the tube is supplied with positive voltage from generator G through resistor 21.

It is clear that the electromotive force picked up by inductor IC due to the communication current, is amplified in the plate circuit of tube V1 in the well-known manner. As an aid to the understanding of the operation of the apparatus, I shall assume that the communication current is a suppressed carrier single side band telephone current whose carrier frequency is of the order of 5700 cycles per second, the voice frequency band for modulating the carrier is of 400 to 2500 cycles per second, and the upper side band of 6100 to 8200 cycles per second is the side band selected for transmission. Thus the plate circuit current of tube V1 has a component corresponding to such communication current received through inductor IC.

The second stage of amplification includes an electron tube whose control grid circuit is coupled to the plate circuit of the first stage tube V1 through a condenser 22. This second stage of amplification is shown conventionally for the sake of simplicity because it can be of any well-known construction and may be substantially a duplication of the first stage, and a description of the second stage is not required for a full understanding of my invention. It is sufficient to point out that the communication current component passed from the plate circuit of tube V1 to the control grid circuit of the second stage is amplified in the usual manner and is supplied from the output of the second stage amplifier to the input side of a demodulator DM through wires 23 and 24.

Demodulator DM may be any one of several well-known forms and is shown conventionally in order to not unduly complicate the drawing because its specific construction forms no part of my invention. For example, this demodulator may be of the balanced type covered by Letters Patent of the United States No. 2,129,313, granted September 6, 1938 to L. D. Whitelock, for Apparatus for electric signaling systems. It is sufficient for the present application to point out that in demodulator DM a carrier from a local oscillator OS is mixed with the side band telephone current supplied through the second stage amplifier, and the carrier is suppressed at a push-pull arrangement of primary winding 25 of a transformer T2 included in the output circuit of the demodulator. Thus one product of demodulation to appear in primary winding 25 is the voice frequencies of the communication current received by inductor IC.

Band pass filter BPF comprises transformer T2, condensers 26 and 27, inductance 28 and at least a portion of winding 29 of an autotransformer T3. This band pass filter is arranged in a well-known manner and is proportioned to pass the voice frequencies and to substantially eliminate the other products of demodulation so that the voltages appearing across winding 29 of transformer T3 are those of the voice frequencies, or at least of a frequency within the selected voice frequency range.

The final and audio amplification stage of the receiving apparatus includes an indirectly heated pentode V5, whose filament is constantly heated and whose control grid 30 and cathode 31 are connected to winding 29 of the band pass filter through a grid circuit to appear shortly. Plate voltage for plate 32 of tube V5 is supplied from generator G through primary winding 33 of an output transformer T4 to whose secondary winding 34 a loud speaker LS is connected. It follows that energy passed by the band pass filter BPF is amplified by tube V5 and is applied to the loud speaker.

An automatic volume control unit AVC is provided for the receiving apparatus. This unit AVC includes a twin triode tube V7, whose filaments are heated in the usual manner. Voltage from a preselected terminal B of filter BPF is applied to control grid 47 and cathode 52 of the right-hand triode of tube V7 as viewed in the drawing, the circuit connection including wire 51, a resistance-capacitance filter comprising resistor 48 and condensers 49 and 50 and a condenser 53. Plate voltage is supplied to plate 56 of the right-hand triode of tube V7 from generator G through wire 13 and resistor 54, the plate circuit being completed from cathode 52 through ground electrodes 55 and 18 to negative terminal N300 of generator G. Thus the communication current voltage appearing at terminal B of the band pass filter is amplified by the right-hand triode of tube V7 of the automatic volume control unit.

The left-hand triode of tube V7 is converted into a triode rectifier by its control grid 57 being connected to plate 58. A bias voltage is applied to cathode 59 of the rectifier through resistors 60 and 61 connected across generator G and a resistor 62 connected between the cathode and a preselected mid terminal of resistor 60. Plate 58 of the rectifier is further connected to a ground electrode 55 through resistor 63. Thus, the cathode 59 of the rectifier is made positive in potential with respect to the plate 58 by a voltage preselected by the connection to resistor 60. The amplified output of the triode of tube V7 is applied to the rectifier section of the tube through condenser 64 connected between plate 56 of the triode and cathode 59 of the rectifier. Consequently, when the voltage from terminal B after amplification at the triode of tube V7 is greater than the bias voltage of the rectifier section of the tube, the voltage is rectified and current flows in resistor 63, the top terminal as viewed in the drawing of resistor 63 being negative with respect to ground electrode 55.

This voltage created across resistor 63 is supplied to the control grid 7 of the first stage tube V1 through a connection including wire 65 and resistor 66. Thus when the communication current is of a large amplitude and a relatively large voltage appears at terminal B of the band pass filter, the first stage tube V1 is provided with an additional negative bias voltage to reduce the amplification gain. If desired, this automatic volume control voltage can be applied to the tube of the second stage of the amplifier by a connection including wire 68 extending from resistor 66 to the grid circuit of the second stage tube.

A condenser 67 is connected in shunt with resistor 63 to form a time delay device, condenser 67 being charged by the rectified voltage and such charge serving to maintain the automatic volume control voltage between syllables and words of the received communication current.

It is to be seen from the foregoing description that I have provided a communication receiving apparatus incorporating an automatic volume control unit which permits adjustment of the receiving apparatus for a relatively low energy level of communication current without excessive loudness when the communication current becomes of relatively high amplitude.

Although I have herein shown and described only one form of apparatus for 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:

In an automatic volume control unit for carrier telephone current receiving apparatus having a first stage amplifier, a demodulator and a band pass filter adjusted to pass voice frequency energy of such telephone current; the combination comprising, an amplifier tube having a plate circuit including a direct current source, an additional filter, a grid circuit including said additional filter to connect a control grid of said amplifier tube to a preselected terminal of said band pass filter to create in said plate circuit an alternating voltage component directly proportional to the voice frequency energy of telephone current applied to said receiving apparatus, said additional filter to substantially suppress carrier frequency energy appearing with said voice frequency energy to assure that said alternating voltage component is substantially directly proportional to the voice frequency energy of the received telephone current, a triode rectifier having a circuit including a resistor and a source of bias voltage poled to bias the cathode of said rectifier a preselected positive voltage with respect to the plate of the rectifier, said amplifier tube plate circuit coupled to said triode rectifier circuit to create a rectified current through said resistor proportional to the magnitude of said alternating voltage component over said bias voltage, and circuit means to connect said resistor to a control grid of said first stage amplifier to apply an automatic volume control voltage due to such rectified current.

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