Nov. 26, 1940. H. W. AUGUSTADT 2,223,200

TELEPHONE REPEATER CONTROL CIRCUIT

Filed July 11, 1939

FIG. 1

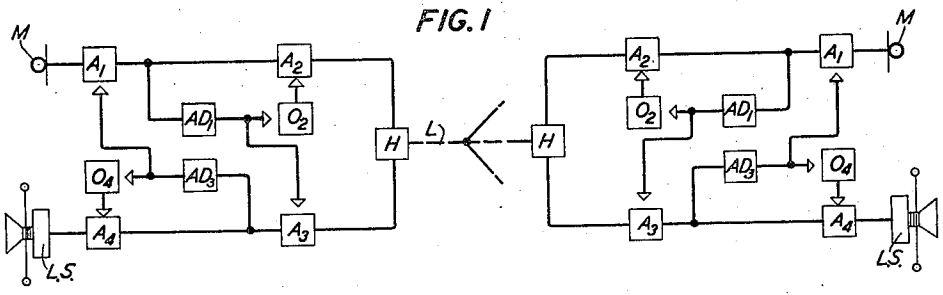


FIG. 2

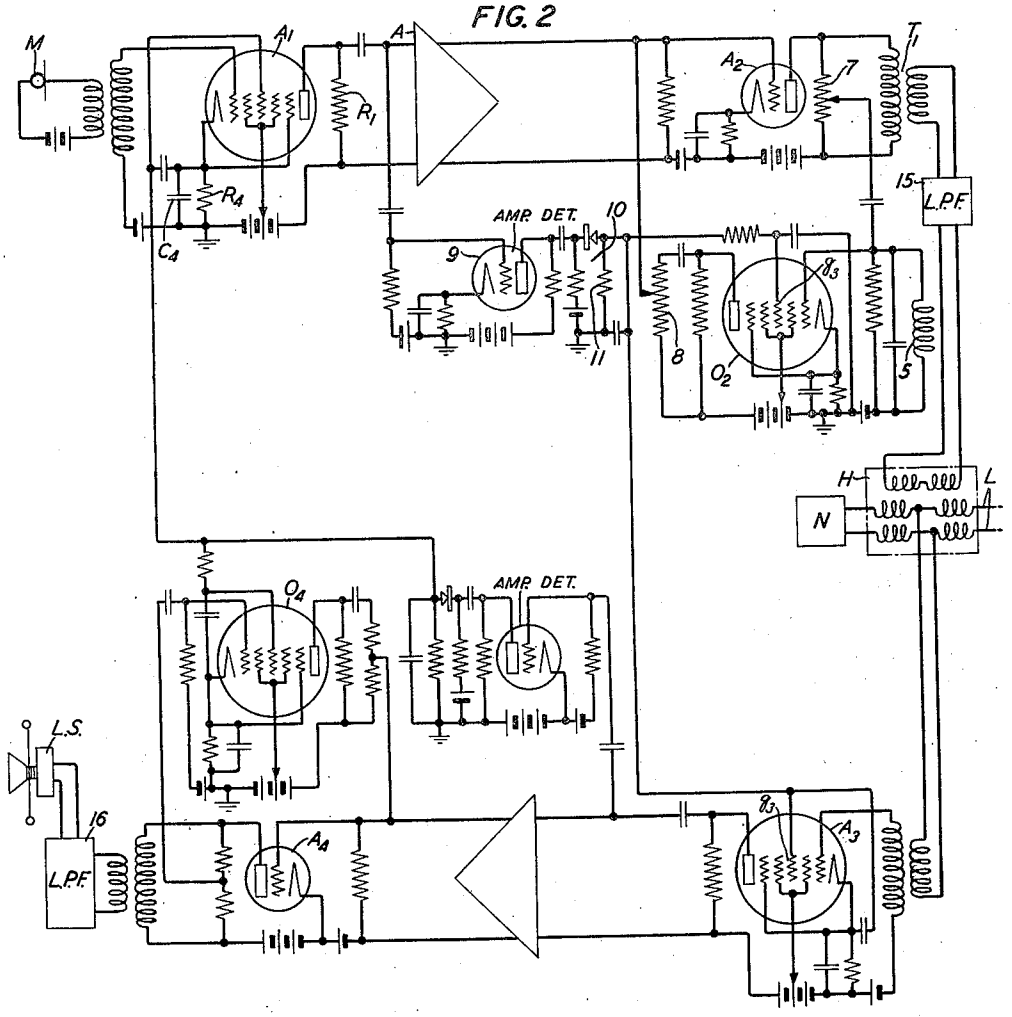
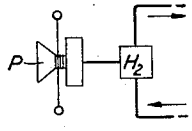


FIG. 3



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TELEPHONE REPEATER CONTROL CIRCUIT

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9 Claims. (Cl. 179—170)

This invention relates to telephone repeater control circuits and more particularly to means to render the telephone circuits normally quiescent and virtually disabled but ready to be rendered active for transmission of signal, and to means for preventing singing around the circuit.

While the invention has applicability in a wide variety of communication circuits, it will be described more specifically in connection with a telephone conference circuit.

In two-way communication systems, especially if the terminals are permanently connected, as is frequently the case in conference circuits, it is highly desirable that when no normal signaling is taking place the system shall be as quiescent as possible, being substantially immune from room noise and other background disturbances. Even during a signaling period, such as conversation, it is desirable that in the pauses and intervals of the usual speech the circuits shall be brought to a highly quiescent condition.

In my invention, as herein described, there is present in a signal path a vacuum tube amplifier which is so associated with another circuit, such as another vacuum tube amplifier, that the first amplifier is part of an oscillatory circuit oscillating at a frequency outside the signaling range, such as an ultra-audio frequency. Under these conditions it is found that the vacuum tube amplifier in the signal path is unable to amplify and transmit the signal. In my circuit, however, when a desired signal is initiated a portion of it is used to develop and supply a voltage which may be applied to the oscillating circuit at some point and in such manner that oscillations are no longer maintained, whereupon the amplifier in the signal path is enabled, permitting the transmission of signals. As soon as the signal ceases, the oscillatory condition is reestablished and the amplifier in the signal path is disabled.

Furthermore, when the circuit at one terminal is arranged for two-way conversation, having a transmit side and a receive side, it is important to prevent singing around the circuit of the terminal, which I accomplish by permitting that side over which signal is passing to substantially disable the other side for the time that the signal continues to arrive.

The invention will be better understood by reference to the following specification and the accompanying drawing, in which:

Fig. 1 is a highly simplified schematic drawing of a circuit embodying my invention;

Fig. 2 is a more detailed drawing of the circuit at one terminal; and

Fig. 3 is a modified form which a portion of the terminal circuit may take.

Referring more specifically to Fig. 2, there is shown a microphone M which feeds into an amplifier, A_1, this amplifier being preferably of a variable mu type. The output R_1 of this amplifier feeds into other amplifiers A, if desired, and the signal is then impressed on amplifier A_2, the output normally going through transformer T_1 to line L.

In the specific form shown in Fig. 2 a second tube O_2 is provided which is so associated with the tube A_2 that the two form an oscillating system, the frequency of which is above the signaling range for which the circuit is to be used. While a wide variety of vacuum tubes O_2 may be used for this purpose, the one illustrated herein is the so-called 6L7 tube and the frequency of oscillations may be determined by any of the circuit constants, such for example, as the anti-resonant circuit 5. A suitable oscillatory condition for the combination of tubes and circuits is obtained by the application of proper voltages and proper resistances in the various parts of the circuit with proper degree of coupling between the two circuits as indicated at 7 and 8. When an implifier such as A_1 is set into an oscillatory condition in such a manner as described, it is unable to act as an amplifier for a signal impressed on its input circuit. If, however, the oscillatory condition is destroyed for a time, then the amplifier will act in the normal manner to amplify and transmit the signal.

When a signal is initiated at the point M it arrives at the input of the tube A_2 but since this tube is in an oscillatory condition, the signal cannot get through. To enable the circuit, a portion of the output of the tube A_1 is diverted through an amplifier 9 and a detector circuit 10 which provides a direct current voltage across the resistance element 11 and this in turn is applied to the grid g_3 of the 6L7 tube O_2. By suitable adjustment of the amplification by tube 9 and the other constants of the circuit, the negative bias thus placed on the grid g_3 is made sufficient to stop the oscillatory condition, whereupon amplifier A_2 becomes operative to transmit the desired signal, which latter will in turn be impressed on the line L. In order to prevent oscillations during the oscillatory condition being impressed on the line, a low-pass filter 15 is introduced in the signal path.

While the arrangement for maintaining oscillations and interrupting oscillations thus described is one which I find particularly satis-

factory, it is to be understood that this is only one of a number of forms which my invention may take. For example, instead of using the tube O_2, the amplifier A_2 could have been made oscillatory in itself by any suitable feedback arrangement from the input to the output. This feedback circuit could then be opened at any desired point by a relay operated from the amplifier detector circuit 10. As another alternative one could insert in such a feedback circuit an element, the resistance of which varies rapidly with impressed voltage. For example, a copper-oxide rectifier unit could be inserted in the feedback circuit and the bias from the rectifier circuit 10 would then be so impressed on the copper-oxide rectifier as to change its resistance and remove the vacuum tube A_2 from the oscillatory condition. All such variations are obvious as are other alternatives which might be suggested, all coming within the purview of my invention.

Such a circuit as described might constitute the transmit end of a four-wire conference circuit. On the other hand, it can readily be adapted as the transmit side of a two-way two-wire communication channel, as is shown in further detail in Fig. 2. In the latter event the output from the amplifier A_2 would be impressed on the line L through the hybrid coil H with the balancing network N in a manner now well understood in the art. The receive side of this two-way terminal starting with the connection from the hybrid coil is identical to that described in connection with the transmit side except that it terminates in more suitable responsive devices, such as a loud-speaker LS. Since the circuit arrangement for this side is identical with the transmit side, it will not be necessary to describe it in detail.

It would be evident, however, that if the gain in the amplifiers on the two sides is quite high and there are slight unbalances in the circuit, then there is danger of setting up a singing condition within the terminal circuits. To prevent such a condition I provide means whereby the side of the circuit which is carrying signal at the moment disables the other side by so reducing its gain that any speech arriving thereat cannot enable its own amplifiers. Thus, consider speech to be initiated at the microphone M. Then there is transmitted from the detector circuit 10 a potential which is impressed on the grid g_3 of the tube O_2 and the grid g_3 of the amplifier A_3, this being a negative potential of such value as to very greatly reduce the gain of the variable mu tube A_3. It is to be understood that the timing of the operations is such that the amplifier A_3 is disabled before amplifier A_2 is enabled. So long as signal continues at M and a corresponding potential is maintained on grid g_3 of tube A_3, the receive side of the circuit is disabled. Upon the cessation of signal at M the gain of the tube A_3 is restored to normal and if signal then comes in over the line it in turn reduces the gain of the tube A_1 in an identical manner, and enables the amplifier A_4.

The whole of the circuit as described in Fig. 2 may constitute one two-way terminal of a more comprehensive telephone system, such as a conference circuit, the remote terminals being identical to the one described in connection with Fig. 2. Such a circuit is shown in Fig. 1 in which two terminals are disclosed although it is apparent that as many other terminals as desired may be associated, as indicated by dotted lines in Fig. 1.

While in Fig. 2 the plate voltage supply for the various tubes is indicated as individual batteries, it is to be understood that in practice one would usually prefer a single B voltage supply which might take on any form, such as a power pack unit. Also, it is evident that for proper operation of the circuits the correct biasing for the different tubes is important. Obviously, any suitable method for obtaining such biasing may be used although in the figure I have in general shown self-biasing, as indicated by resistances with by-pass condensers.

In the description above and in the drawing the so-called 6L7 tube has been used in a number of places. I find this a particularly convenient tube because of the ease with which the gain of the tube can be adjusted by voltage bias on the grid g_3. It is to be understood, however, that my invention is not limited to this form of variable mu tube but that any tube or combination of tubes equivalent thereto may be used.

At the terminal the pick-up and the receiver are shown as separate instruments. It would be desirable in some cases to replace these by a single device serving both as a pick-up and as a receiver. Such a modification is shown in Fig. 3 in which P serves the double function and is associated with the transmit and the receive side of the terminal through a hybrid coil H_2 in a manner well understood in the art.

What is claimed is:

1. In a signaling circuit comprising a signal amplifier, means for normally blocking the amplifier as a signal amplifier, said means comprising a circuit including said amplifier normally oscillating at a frequency outside the signal frequency range, and means for rendering the oscillating circuit non-oscillatory to render said amplifier operative to amplify signals, said last means becoming effective on receipt of a desired signal wave.

2. In a telephone circuit comprising a line signal amplifier, means for normally blocking the amplifier, said means comprising a second amplifier forming with the first an oscillating circuit normally oscillating at a frequency above the signal frequency range, and means for rendering the said second amplifier inoperative to stop the oscillations in said circuit, said last means becoming effective on receipt of a desired signal wave.

3. The combination of claim 2 characterized in that said second amplifier comprises an amplifying vacuum tube having a control electrode, and the received signal wave applies a negative biasing voltage to said control electrode to disable said tube.

4. In a signal transmission system, a signal transmission path including an amplifier, a vacuum tube forming with said amplifier a circuit oscillating at a frequency above the signal frequency range and thus preventing said amplifier from transmitting frequencies within said range, and means responsive to signals initiated in said path to apply a blocking bias to said vacuum tube to stop oscillation of said oscillating circuit whereby the amplifier is rendered operative to transmit said signals.

5. The combination of claim 4, characterized by the fact that said vacuum tube has a grid-cathode circuit including a series resistance and the signal responsive means comprises an amplifier rectifier unit having its input connected across said path in front of said amplifier and its output connected across said resistance.

6. In a two-way communication system, an

amplifier associated with the transmit side of one terminal and an amplifier associated with the receive side of that terminal, a vacuum tube associated with each of the said amplifiers and so adjusted that each circuit, comprising an amplifier and a vacuum tube, oscillates at a frequency above signal frequency range thus blocking the amplifier for signal frequency and rendering the circuit quiescent, and means responsive to the application of signals of given amplitude to the input of the amplifier in either side of said terminal to render the amplifier-vacuum tube combination on that side of the terminal non-oscillatory so that the amplifier of the combination is rendered operative to amplify the applied signals.

7. The combination of claim 6, characterized by the fact that when signal of sufficient amplitude arrives at one side the signal responsive unblocking means on that side renders the other side substantially inoperative for signal transmission.

8. The combination of claim 6, characterized by the fact that there is a preamplifier for the transmit and a preamplifier for the receive side, and means by which the signal responsive unblocking means on the side taking control places a bias on the preamplifier on the other side to substantially reduce its gain.

9. A combination of claim 6, characterized by the fact that there are a plurality of such terminals linked together for intercommunication.

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