Feb. 6, 1940. L. J. ANDERSON 2,189,306

PUBLIC ADDRESS STABILIZING SYSTEM

Filed Nov. 28, 1936

FIG. 1.

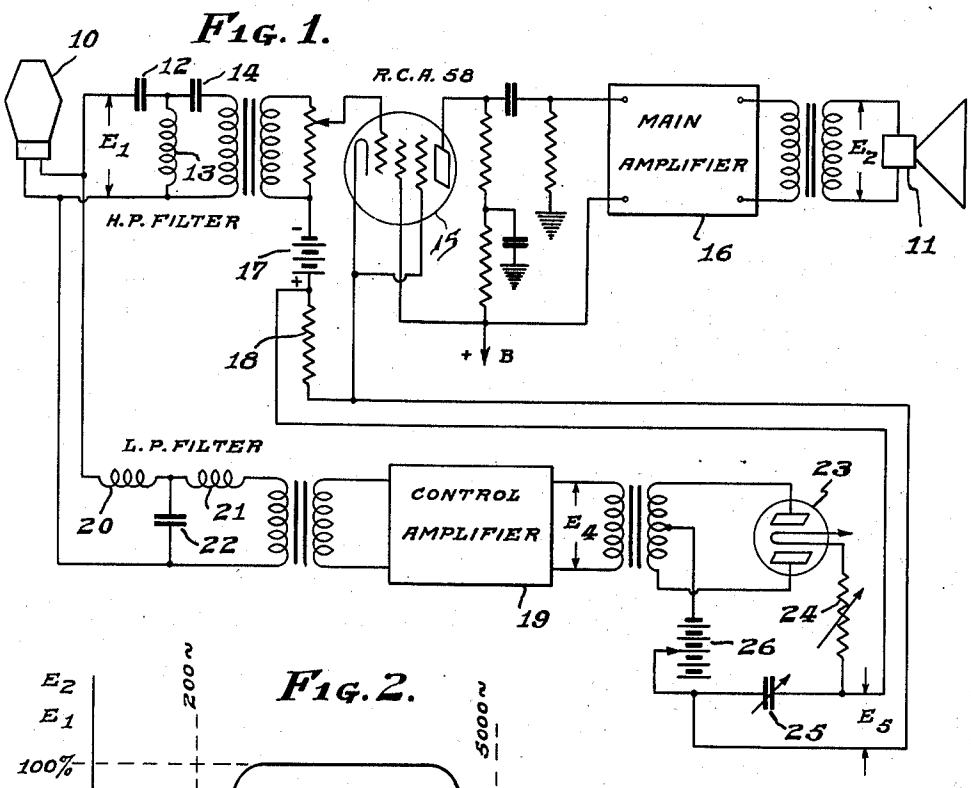


FIG. 2.

FIG. 3.

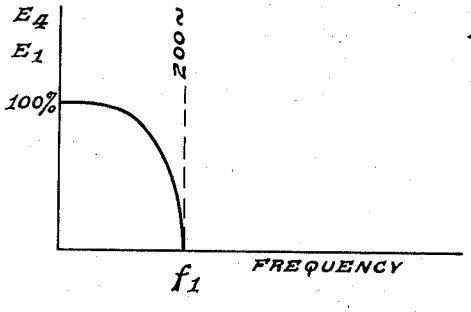
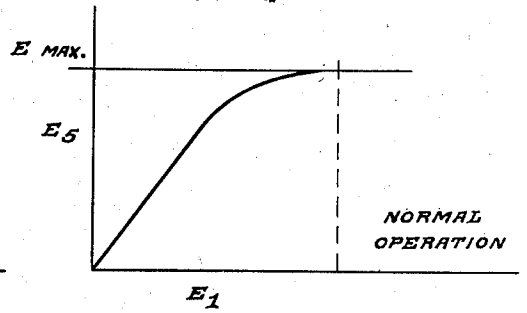


FIG. 4.



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PUBLIC ADDRESS STABILIZING SYSTEM

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6 Claims. (Cl. 179—171)

My invention relates to signal transmitting and receiving systems, such as are utilized for public address, sound reinforcement or like purposes, and has for its principal object the provision of an improved apparatus and method of operation whereby undesired feed-back from the loud speaker to the microphone of such systems is avoided.

Such feed-back between acoustically coupled sound reproducing and pick-up devices, commonly designated as "singing" results from sound which (1) is produced by the loud speaker, (2) is picked up by the microphone, and (3) produces a corresponding electrical current which is amplified and fed to the loud speaker. If the microphone and loud speaker are in the same room, the amount of sound amplification which can be employed is practically always limited by the feed-back or "singing" point. Such "singing" almost always occurs at the frequency at which the overall amplification is at a maximum. This involves the complete circuit, starting with the microphone and ending with the sound received by the microphone from the loud speaker, thus including such sound reinforcement or sound losses as are imparted by the entire acoustical environment. The microphone may be especially sensitive at one frequency, or the loud speaker may be especially efficient at a particular frequency, or the amplifier may have a peak at a certain frequency. All these factors have a part in determining the frequency at which feed-back or "singing" becomes evident.

It has been found that the usefulness of a sound reinforcing system is greatly enhanced by minimizing all of the peaks in the system so that the overall characteristic is as nearly uniform with respect to frequency as possible. Further advantage has been taken of the directive properties of both microphones and loud speakers in order that the microphone may receive a minimum of sound from the loud speaker as compared with the sound which the loud speaker radiates toward the hearers, and the sound which the microphone receives from the original source. In spite of what it has been possible to accomplish by the aforementioned measures, the usefulness of public address systems is still seriously limited by feed-back or "singing."

It has been proposed to provide the amplifier of a public address system with a slow acting automatic volume control of the "compressor" type, for reducing the amplification when there is any prolonged sound. This would serve to stop feed-back if the sustained sounds were due to feed-back, but no satisfactory arrangement has been proposed that will enable the microphone to distinguish between feed-back sounds and sounds which it is desired to amplify.

A possible solution of the problem is the provision of means for causing the amplification to be momentarily increased in response to voice sounds. A quick acting expander circuit having a limited range of volume control may be employed for this purpose. The theory of this approach to the problem is that the high amplification condition does not last long enough to permit the building up of feed-back oscillations.

In accordance with the present invention, feed-back between the sound reproducer and pick-up devices is minimized by the provision of a signal amplifier which is biased to low gain or substantially to cut-off in the absence of signal impulses, and has its gain increased in response to the presence of such impulses. Stated more specifically, a signal channel biased substantially to cut-off and fed through a high pass filter is arranged to have its gain controlled by a control circuit which is fed through a low pass filter and overloads at a predetermined signal level.

The invention will be better understood from the following description when considered in connection with the accompanying drawing, and its scope is indicated by the accompanying claims.

Referring to the drawing:

Figure 1 is a wiring diagram of a public address system embodying the invention,

Figure 2 is an explanatory diagram showing the gain of the main signal channel at different frequencies,

Figure 3 is a similar diagram relating to the operation of the control channel, and

Figure 4 shows the relation between the input and output voltages of the control channel.

The system of Fig. 1 includes a sound pick-up device or microphone 10, from which signals are supplied to a loud speaker 11 through a signal channel which includes a high pass filter 12, 13, 14, an amplifier stage 15 which may be of the RCA Radiotron 58 type, and a main amplifier 16. The amplifier stage 15 is substantially biased to cut-off by means of a potential source shown as a battery 17 which is connected in series with a resistor 18.

Signal impulses are also supplied from the microphone 10 to a control amplifier 19 through a low pass filter 20, 21, 22. The output of the amplifier 19 is rectified by a rectifier 23, and the rectified or detected current is supplied to the resistor 18, an adjustable potential source, shown as a battery 26, being included in the output circuit for the purpose of bucking out small variations in the rectifier output. The potential produced in the resistor 18 is of such polarity as to make the control grid of the amplifier 15 more positive and permit the transmission of signals through the main channel. In order to properly time the building up of this bias potential, resistor 24 and capacitor 25 are provided

in the output of the control circuit. As previously indicated, the control amplifier 19 is so designed that it overloads at a predetermined signal level, thus preventing further increase in the bias potential of the resistor 18.

As indicated more clearly by Fig. 2, the gain of the main channel may be made to increase at a predetermined frequency, such as 200 cycles, to a predetermined level, and to decrease at a higher frequency, such as 5,000 cycles, for example, this level being determined by overloading of the control channel, and the decrease being effected by suitable design of the coupling transformers or other parts of the main channel. While a range of 200 to 5,000 cycles has been indicated for purposes of illustration, it will of course be understood that any frequency range may be utilized.

The average male voice contains frequencies preponderantly below 200 cycles and in all speech there is present a considerable quantity of frequencies below 200 cycles. In addition to this, all speech contains a very large percentage of waves which are not true sine waves. Many of these waves are substantially square-fronted waves and therefore produce response at all frequencies. A velocity microphone is preferably used with speech close thereto. The characteristics of this microphone are such that speaking close to the microphone greatly accentuates the response to low frequencies and particularly those below 200 cycles. As a consequence, when any speech is impressed on the microphone 10 a sufficient quantity thereof produces response below 200 cycles to actuate the control amplifier and rectifier and thereby supply sufficient biasing voltage to the tube 15 to render it properly conducting.

If desired, of course, the main channel may carry considerably higher frequencies than 200 cycles as, for example, 300 or 400 cycles, as the presence of low frequencies is not essential to understanding the human voice. In this case, the low pass filter would be arranged to carry a correspondingly greater range of frequencies.

As indicated by Fig. 3, the gain of the control channel may be caused to decrease as the frequency increases, a minimum gain being reached at some selected frequency, such as 200 cycles. Under these conditions, the relation between the microphone output voltage and the output voltage of the control circuit is as indicated by the curve of Fig. 4.

Under these conditions, no feed-back between the microphone and speaker is possible. Thus, when speech is picked up, in the microphone, the control channel is actuated in such a way as to apply a bucking bias to the stage 15 of the main amplifier. This stage then functions as an amplifier, and as a result the amplified speech impulses are heard at the speaker. The loud speaker is prevented from actuating the control channel by the filter 20, 21, 22. The output from the rectifier 23 is maintained substantially constant during the transmission of signals, due to the fact that it overloads when a predetermined signal level has been reached. It has been found that the use of a velocity microphone is advantageous in this type of system, for the reason that in close talking the large velocity effect voltage may be used advantageously in the control channel.

I claim as my invention:

1. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of means for restricting the input of said amplifier to impulses of relatively high frequency, means for biasing said amplifier to a low signal level, and means responsive to relatively low frequency impulses for applying a counter-bias to said amplifier.

2. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of means for restricting the input of said amplifier to the relatively high frequency components of the output of said pick-up device, a control channel for controlling the gain of said amplifier, and means for restricting the input of said control channel to the relatively low frequency components.

3. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of means for restricting the input of said amplifier to the relatively high frequency components of the output of said pick-up device, a control channel for controlling the gain of said amplifier, means for restricting the input of said control channel to the relatively low frequency components of the output of said pick-up devices, and means for timing the action of said control channel.

4. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of means for restricting the input of said amplifier to the relatively high frequency components of the output of said pick-up device, a control channel for controlling the gain of said amplifier, means for restricting the input of said control channel to the relatively low frequency components of the output of said pick-up devices, and means for eliminating relatively small variations in the output of said control channel.

5. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of means for restricting the input of said amplifier to the relatively high frequency components of the output of said pick-up device, a control channel for controlling the gain of said amplifier, and means for restricting the input of said control channel to the relatively low frequency components of the output of said pick-up devices, said control channel being arranged to overload at a predetermined level of said relatively low frequency components.

6. In a system including an amplifier connected between acoustically coupled sound pick-up and reproducing devices, the combination of a signal channel including a high pass filter, means for biasing said channel substantially to cut-off, a control channel including a low pass filter and arranged to apply to said signal channel a counter-bias potential whereby signal impulses are transmitted to said channel only in response to the presence of speech current in the output of said pick-up device.

LESLIE J. ANDERSON.