

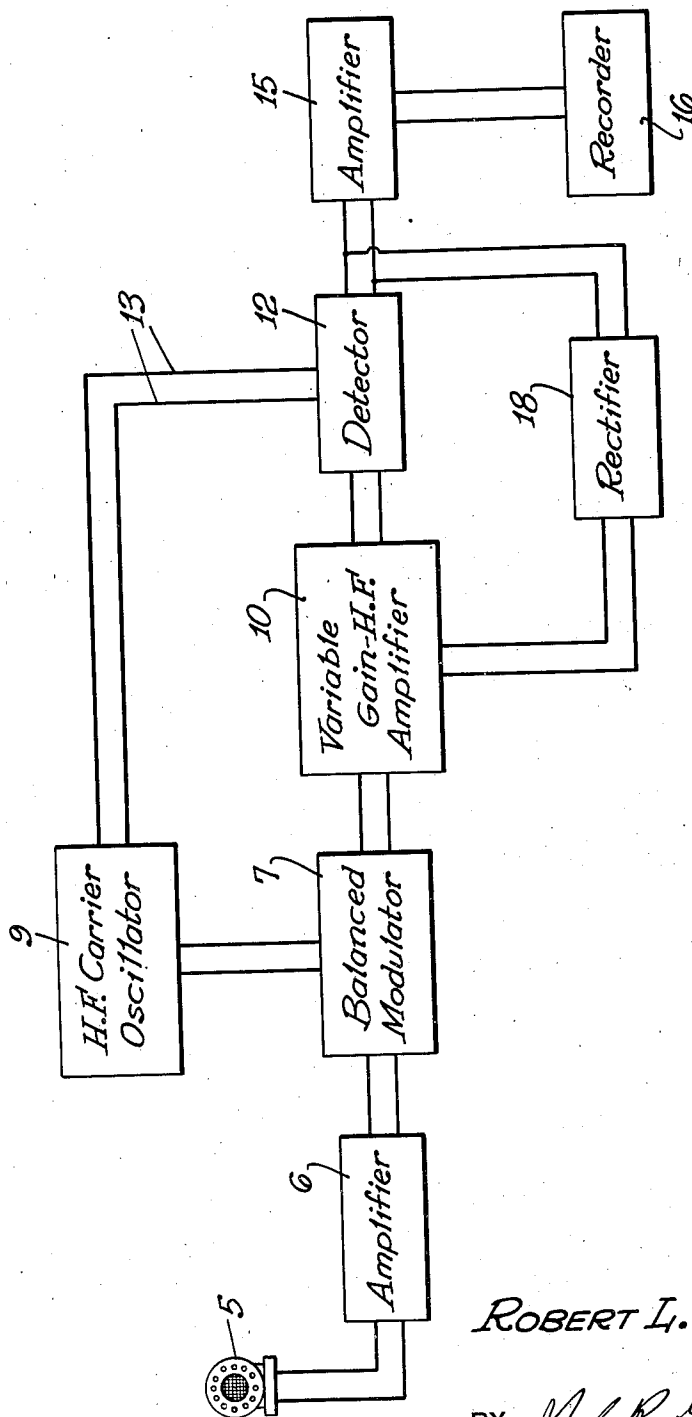
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VARIABLE GAIN AUDIO AMPLIFIER SYSTEM AND METHOD

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VARIABLE GAIN AUDIO AMPLIFIER SYSTEM
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8 Claims. (Cl. 179—171)

This invention relates to current transmission systems and particularly to the automatic control of the gain or attenuation of such systems.

Electrical current transmission systems are well-known, the present invention being directed to a transmission system wherein the gain or attenuation is automatically varied in accordance with the amplitude of the original signal. Although the invention as described hereinafter is applied to a sound recording system, it is to be understood that it is also applicable to radio, broadcasting, public address systems, and other types of communication systems. Furthermore, it is being shown embodied in a compressor system wherein the input level range of the signal being transmitted is compressed into a narrower range of output levels although by changing the connections, it may be embodied in an expander which increases the range of output levels with respect to the input level range.

In compressor systems of this type, such as shown in Singer Patent No. 2,255,683 of September 9, 1941, balanced or push-pull amplifier units are employed, one unit of which is of the variable gain type wherein its gain is controlled by a rectified portion of the transmitted signal. For the successful operation of such systems, it is necessary in order to eliminate distortion, that a substantially perfect balance be obtained and maintained between each longitudinal section of the push-pull circuit. This balancing involves the matching of the electronic vacuum tubes and the other circuit elements such as resistances, capacitors, and inductances. To determine this balance, special test circuits have been provided and are used, one such test system being disclosed and claimed in a copending application Serial No. 448,576 of June 29, 1942.

The present invention is directed to an automatic variable gain amplifier system wherein the former deleterious effects of any unbalance between the push-pull sections thereof are eliminated. This is accomplished by the use of a high frequency carrier modulator system which does not transmit the audible disturbance caused by any unbalanced condition in the system.

The principal object of the invention, therefore, is to provide an improved method of varying the amplitude ratio of transmission of electrical currents.

Another object of the invention is to facilitate the automatic control of gain variations in an electrical current transmission system.

A further object of the invention is to provide an improved system for automatically controlling

the amplitude of transmission of electrical currents.

A still further object of the invention is to provide a compressor or expander system in which the variable gain amplifier is operated as a high frequency modulated carrier system to eliminate audio frequency variations due to unbalance from being introduced into the controlled transmitted currents.

Although the novel features which are believed to be characteristic of this invention will be pointed out with particularity in the appended claims, the manner of its organization and the mode of its operation will be better understood by referring to the following description read in conjunction with the accompanying drawing forming a part hereof, in which the single figure is a block diagram of a sound recording system embodying the invention.

Referring now to the drawing, the output of a signal generator, such as a microphone 5, or any other signal source, such as a disc or film record, is connected to an amplifier 6. The output of the amplifier 6 is impressed upon a balanced modulator 7 upon which is impressed high frequency current from the oscillator 9. As the signal modulates the carrier frequency, it is impressed upon a variable gain amplifier 10 which may be of the type shown in the above-mentioned Singer patent. By the use of the balanced modulator 7, the carrier current is suppressed in the output of the modulator and only the side bands are transmitted to the variable gain amplifier 10. The output of the variable gain amplifier is connected to a detector 12 to which the carrier oscillator is connected over conductors 13. After detection, the signal is again amplified in an amplifier 15 and then impressed upon a recorder 16, it being understood that the signal may also be impressed at this point upon a radio broadcast transmitter or on a loud speaker for reproduction.

For varying the ratio of the amplitudes of the signal as impressed on amplifier 15 with respect to the amplitudes impressed on the amplifier 6, a portion of the output of detector 12 is impressed upon a rectifier 18, the rectified current being impressed upon the gain control electrodes of the variable gain amplifier 10, in accordance with the detailed circuit shown in the above-mentioned Singer patent.

The present system operates as follows. The amplified signal in amplifier 6 modulates the carrier frequency from oscillator 9 which frequency should be in the neighborhood of 1000 kilocycles and up. The modulated side bands

are then impressed upon the variable gain amplifier 10 and detected by the detector 12 to which the missing carrier is supplied over conductors 13. The output of the detector is fed to the rectifier 18, the output of which controls the gain of the amplifier in accordance with the signal level.

In the normal audio compressor or expander circuit, any unbalance in the variable gain amplifier introduces distortion in the form of "thump" disturbances, this type of distortion being well understood in the art. In the present system, however, any unbalance in the high frequency variable gain amplifier does not result in the introduction of "thump" distortion in the final output signal because the amplifier will not pass disturbances of such a low frequency and consequently they will not appear in reproduction. Although very rapid gain changes are present in such compressors, these changes are not fast enough to cause disturbances having frequency components above 1000 kilocycles. In this manner, therefore, the accurate balancing now required for automatic compressor and expander circuits is eliminated and the system will operate free of distortion components normally introduced due to unbalance in the system at any time.

Although the input to the rectifier 18 is shown connected to the output of the detector 12, it is to be understood that this input may also be obtained from the output of amplifier 8.

I claim as my invention:

1. In an electrical current transmission system, the combination of a source of signal currents, a source of high frequency currents, means for modulating said high frequency currents with said signal currents, an amplifier for said modulated currents, a detector of said modulated currents, and means utilizing a portion of the output currents of said detector for varying the gain of said amplifier in accordance with the amplitude of said signal currents.

2. An electrical current transmission system in accordance with claim 1 in which said modulating means is a balanced modulator whereby said high frequency currents are eliminated from said amplifier.

3. In an electrical current transmission system, the combination of a source of signal currents, a source of high frequency currents, means for modulating said high frequency currents with said signal currents, an amplifier for said modulated currents, and means for varying the gain of said amplifier in accordance with the amplitude of said signal currents, said last mentioned

means including a detector of said amplified modulated high frequency currents and a rectifier for a portion of said detected currents, the output of said rectifier being connected to said amplifier.

4. The method of automatically varying the transmitted amplitudes of signal currents comprising modulating a high frequency carrier with said signal currents, amplifying the modulated currents, detecting said modulated currents, rectifying a portion of said detected currents, and varying the amplification of said modulated currents with said rectified currents.

5. The method in accordance with claim 4 in which the modulation of said high frequency carrier eliminates said carrier, said carrier being independently supplied during the detection of said modulated currents.

6. A compressor system comprising a carrier current source, a signal source, a balanced modulator for modulating the carrier currents with the signal currents, an amplifier for the products of modulation, a detector of said products of modulation, and means utilizing the output currents of said detector for automatically controlling the rate of amplification of said products of modulation in accordance with the amplitudes of said signal currents.

7. A compressor system comprising a carrier current source, a signal source, a balanced modulator for modulating the carrier currents with the signal currents, an amplifier for the products of modulation, and means for automatically controlling the rate of amplification of said products of modulation in accordance with the amplitudes of said signal currents, said last mentioned means including a detector of said products of modulation and a rectifier of a portion of said detected currents, the output of said rectifier being connected to the gain control electrodes of said amplifier.

8. An automatic volume control system comprising a source of signal currents to be controlled, a high frequency carrier current source, a modulator for modulating said carrier current by said signal currents, an amplifier for said modulated currents, a detector for said amplified currents, and a rectifier for a portion of said detected currents, the output of said rectifier being connected to said amplifier, variations in amplitude of said rectified currents varying the gain of said amplifier.

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