

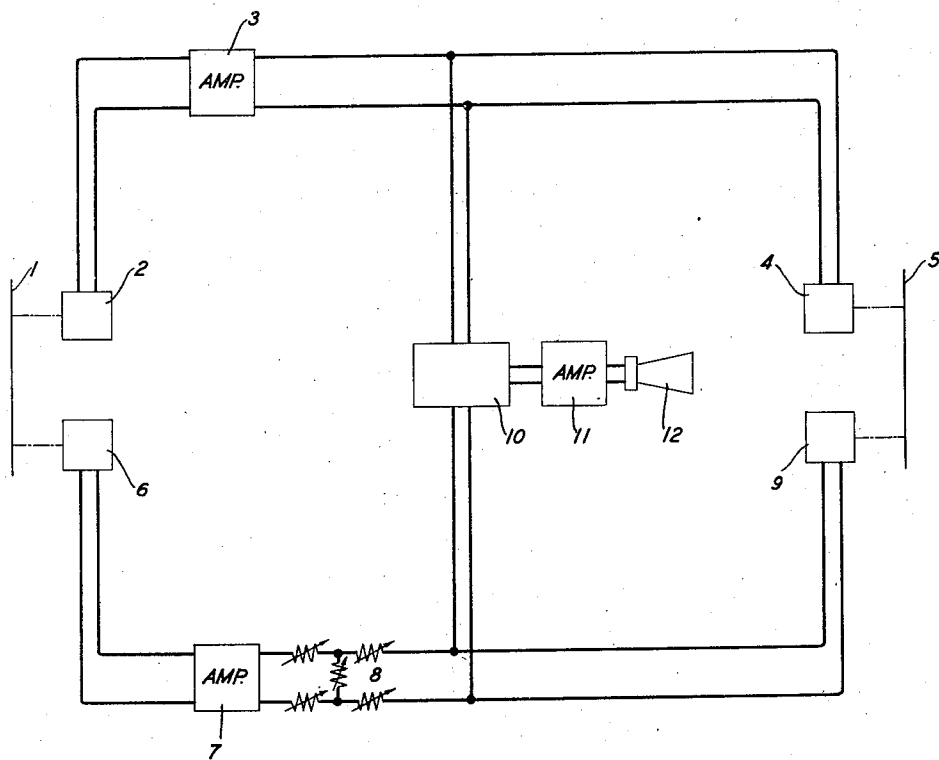
Aug. 26, 1941.

H. FLETCHER

2,254,034

SOUND RERECORDING SYSTEM

Filed April 5, 1940



INVENTOR
H. FLETCHER
BY

G. H. Heydt.

ATTORNEY

UNITED STATES PATENT OFFICE

2,254,034

SOUND RERECORDING SYSTEM

Harvey Fletcher, Flushing, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application April 5, 1940, Serial No. 328,071

3 Claims. (Cl. 179—100.1)

This invention relates to sound rerecording systems and particularly to systems for rerecording volume compressed records.

Sound recording systems are known in which the volume range of the original sound is reduced or compressed and a separate record is made of the degree of compression. This separate record of the degree of compression, which may conveniently be called a control record, may be recorded as a slowly varying direct current, as shown in United States Patent 1,623,756, April 5, 1927, C. F. Sacia, or as a modulated carrier current as shown in United States Patent 2,069,810, February 9, 1937, H. D. Arnold.

The object of the present invention is, during rerecording, to arbitrarily vary the volume level of the rerecorded currents so as to enhance the volume contrast in the reproduced music.

A feature of the invention is, during rerecording to arbitrarily vary the rerecorded control current, in such manner as will result in a desired variation of the volume of the reproduced sound without impairing the function of the control current to restore the original volume variation in the sound.

The drawing shows in diagrammatic form a rerecording system including one embodiment of the invention.

The compressed sound is reproduced from the record 1 by the pick-up device 2 and, after suitable amplification, in the amplifier 3, is rerecorded by the recorder 4 on the recording medium 5. If desired, adjustable frequency discriminative networks may be associated with the amplifier 3 in the usual manner to modify the frequency pattern of the rerecorded sound. The pick-up device 2 is of any suitable design adapted for reproducing the record on the record material 1.

The control record, on the record material 1, is reproduced by the pick-up device 6 and, if desired, amplified in the amplifier 7. After amplification, the control currents are supplied through the variable attenuator 8 to the recorder 9 and are recorded on the recording material 5. The attenuator 8 is shown as a balanced variable resistance network, but any other form of attenuator or potentiometer may be used as desired. A portion of the signal currents in the output of the amplifier 3 are supplied to the expander 10 and, after suitable amplification in the amplifier 11, are reproduced by the monitoring reproducer 12. The control currents in the output of the attenuator 8 are also supplied to the expander 10 to control the automatic ex-

pansion of the volume range, and also to control the arbitrary volume level about which this expansion takes place.

The amount of arbitrary enhancement of the volume range afforded by manipulation of the attenuator 8 is limited by the characteristics of the compressor used in the channel which produced the original record 1, and the characteristics of the expander which will be used in the channel used for the reproduction of the rerecorded record 5, this expander preferably having the same characteristics as the expander 10. As a control current is used for the control of the compressors and expanders, the degree of compression in the compressed range may be substantially complete, as shown in United States Patent 1,623,756 to Sacia. The compression and expansion need not be used throughout the whole range of volume recorded, that is, the lower volume levels may be rerecorded and reproduced without compression and expansion, only the higher levels of volume being compressed in order to prevent overloading of the recording device. However, no matter what type of compression and expansion is used, the expander 10, and the expander used in the reproducing channel, must have a range of expansion larger than the range used in compression, that is, the range used in compression plus the variation imposed on the control current by the attenuator 8, must not exceed the available range of expansion in the expander 10, or in the expander in the reproducing channel. In a typical embodiment of the invention, compression is applied to the upper thirty decibels of the volume range and compresses this range into a range of some ten decibels on the original record. The compressor in the recording channel thus operates over a range of thirty decibels. The expander 10, and the expander in the reproducing channel operate over an expanded range of fifty decibels. Thus the manipulation of the attenuator 8 can shift the operating range of the expander 10, ten decibels above or below normal without interfering in any way with the automatic expansion of the volume range.

While only a single rerecording channel has been disclosed, it is evident that this invention is applicable to a multichannel rerecording system, such as a stereophonic rerecording system and that the control current may be either a slowly varying direct current or a selected carrier current.

What is claimed is:

1. In a rerecording system, a record medium

having a record of electrical waves compressed as to volume range and a control record of the degree of compression applied to the waves during recording, means for reproducing and rerecording said record of electrical waves, means energized by said reproduced wave for audibly reproducing said electrical waves, means for reproducing and rerecording said control record and for controlling said audible reproduction and a manually variable attenuator in the channel for rerecording said control record.

2. In a rerecording system, a record of waves modified in amplitude, a record of the modifications made in the amplitudes of said waves, a pick-up for said record of modified waves, a recorder associated with said pick-up, a pick-up for said record of modifications, a recorder associated with said latter pick-up, and a manually variable attenuator in the circuit connecting said latter pick-up and said associated recorder.

3. The method of enhancing the amplitude of reproduced waves which comprises recording the waves modified in amplitude, recording the modifications made in the amplitudes of said waves, rerecording the record of said waves, rerecording said modifications, arbitrarily changing the magnitude of said modifications at desired times during rerecording without changing the pattern of said modifications, reproducing said recorded record of said waves, reproducing the changed record of said modifications, and controlling the reproduction of said waves by the changed record of said modifications to restore the amplitude variations of the original waves, and to enhance the amplitude variations in the reproduced waves.

HARVEY FLETCHER.