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ARTIFICIAL REVERBERATION CONTROL APPARATUS

Filed July 21, 1959

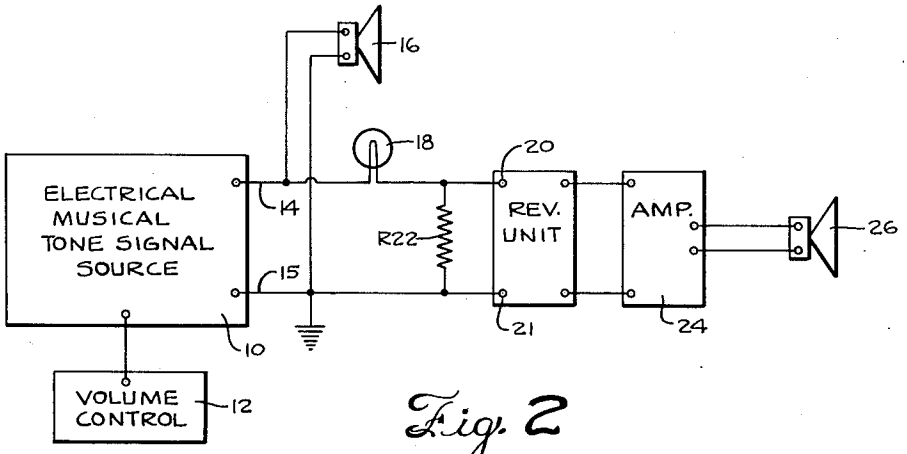


Fig. 2

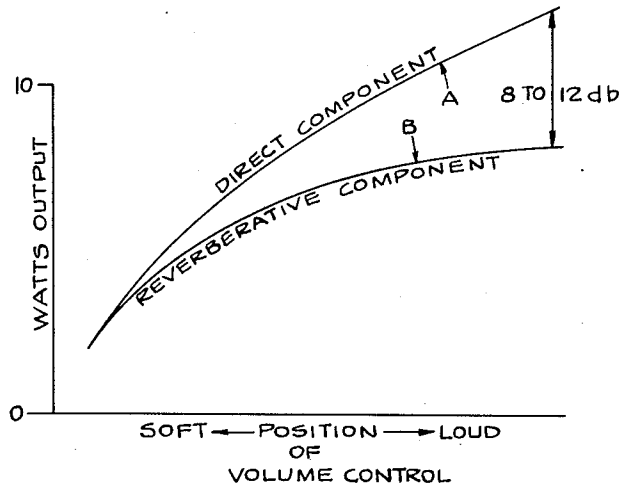


Fig. 1

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ARTIFICIAL REVERBERATION CONTROL APPARATUS

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This invention relates generally to acoustic systems and apparatus, and more particularly to a method and means for controlling the extent or intensity of the sound.

The invention comprises a novel form and method of reverberation control in which the degree or amount of reverberative effect is a variable factor, depending upon the loudness of the sound produced, or reproduced. In the past, musicians have discovered that there is no single reverberative auditorium which is effective to produce the desired amount of reverberation for all classes of music. For example, in a large cathedral the long reverberative roll associated with the tones is highly effective for slow moving religious music of the choral or hymn type, but when the musician attempts to play fast moving music, in which full chorded progressions occur in rapid succession, he immediately discovers that the inherent long reverberation period causes the music to be blurred and musically ineffective. For music of the latter type, as well as rhythmic music in which interesting and rapid moving figures are employed, the musician finds it desirable to produce the music in a much smaller enclosure, such as an acoustically dead broadcasting studio or the like.

There is no optimum hall for all classes of music. The reveberative time is related to the musical or emotional character of the music being rendered. Furthermore, the loudness of the music itself is reflected in the character of the music. For example, slow moving music is highly effective when played softly, whereas fast intricate contrapuntal music is far more effective when played at a higher intensity so that the listener may clearly hear the inner part music for the various voices. From this it is clearly seen that reverberative auditoriums are, musically speaking, limited in their usefulness.

These limitations are also found to be true for music having artificially introduced reverberation by such means as disclosed in the patent to Laurens Hammond, No. 2,230,836. The reverberation apparatus shown therein is merely a substitute for, or reinforcement of, the natural reverberation occurring in the listening enclosure.

The purpose of the present invention is to provide an improved means for causing the amount of reverberation for any desired volume or intensity level to be of optimum value, that is, for loud audio signals the amount of reverberation is automatically reduced, while for soft signals the intensity of reverberative component relative to the nonreverberative component is considerably increased.

A further object is to provide a greatly simplified and inexpensive apparatus for accomplishing the foregoing object.

Other objects will appear from the following description, reference being had to the accompanying drawing, in which:

FIG. 1 is a chart or graph illustrating the objects and results of the invention; and

FIG. 2 is a schematic wiring and block diagram of the apparatus employed.

Referring to FIG. 1, the vertical coordinate (ordinate), in this case represents the output in watts, on a logarithmic scale, and the horizontal coordinate (abscissa) represents the relative position of the swell pedal of an electric organ, or output voltage of some other electrical musical signal source. Curve A represents the "direct signal" and is approximately a straight line, while the curve B represents the reverberative portion of the signal. These curves show that at low wattage output the intensity of reverberative component rises generally as the intensity of the direct component, but that as the output voltage of the signal source increases to an extent to make the sound "loud" the reverberative component changes little in intensity. At the maximum output voltage of the source, or at the maximum open position of the swell pedal, the intensity of the reverberative component of the sound is approximately 9 to 12 db (decibels) lower than that of the direct signal.

The apparatus by which these results may be obtained is quite simple, comprising a source **10** of musical tone signals which may be a phonograph, a microphone, a radio receiver, an electrical musical instrument such as an organ, or the like.

The output amplitude of the source may be controlled by a volume control **12** of any suitable nature. Conductors **14** and **15** are connected to the output terminals of the source and are also connected to the voice coil of a speaker **16** which may be supplied from the conductors **14** and **15** through an amplifier. A filamentary electric incandescent lamp **18** is connected between conductor **14** and an input terminal **20** of a reverberation unit, the other input terminal **21** thereof being connected to conductor **15**.

A coupling and load resistor R22 is connected across the input terminals **20** and **21** of the reverberation unit. This unit may be made of any suitable type, such as that disclosed, for example, in the patent to Laurens Hammond, No. 2,230,836. The output of the reverberation unit is coupled through an amplifier **24** to a second speaker **26**. The speakers **16** and **26** are preferably placed adjacent one another, facing in different directions.

The incandescent lamp **18** offers no appreciable resistance when the filament is cold, and thus at low output wattage of the source the signal supplied to the reverberation unit **21** is effectively about the same as that supplied to the speaker **16**. However, as the volume control **12** is operated to increase the output of the source, the resistance of the filament of the lamp **18** gradually increases until at higher output from the source it offers substantial resistance such that the reverberative component does not increase as rapidly as the direct component supplied by the speaker **16**, until at very high volume, the output of the speaker **26** is from 8 to 12 decibels (db) less than that of the direct component supplied by the speaker **16**.

The lamp **18** is intended to be representative of any suitable resistance device which has an increasing temperature coefficient of resistivity as its temperature is raised. Such resistive device may also comprise several individual resistances connected in parallel or in series, or in some other mesh, to obtain the desired decrease of the reverberative component relative to the direct component as the volume of the sound produced is increased, with the end result that the relative intensity of the reverberative and nonreverberative tones shall vary generally in accordance with the curves A and B of FIG. 1. A General Electric GE12, 6.3 volt, .15 ampere lamp is economical and has a suitable time constant.

While I have shown and described a preferred embodiment of my invention, it will be apparent that numerous variations and modifications thereof may be made without departing from the underlying principles of the invention. I therefore desire, by the following claims, to include within the scope of the invention all such variations and modifications by which substantially the results of my invention may be obtained through the use of substantially the same or equivalent means.

I claim:

1. For use in translating music from a source into sound, the combination of a pair of first and second channels coupled to the source, each channel terminating in an electroacoustic translating means, the first of said channels having means coupling its electroacoustic translating means directly to the source, the second channel including a reverberation unit and amplifier coupled between the source and the electroacoustic translating means, means for controlling the overall loudness of the sound produced by both of the electroacoustic translating means, and means for reducing the loudness of the signal transmitted through the second channel relative to that transmitted through the first channel as the overall loudness is increased by the means for controlling the overall loudness, the means for reducing the loudness comprising an impedance element coupled between the source and the reverberation unit, said impedance element having a relatively high temperature coefficient of resistivity.

2. The combination set forth in claim 1, in which the impedance element comprises an incandescent lamp.

3. For use in translating musical tone signals from a source into sound, the combination of a pair of first and second channels coupled to the source, each channel terminating in an electroacoustic translating means, the first of said channels having means coupling its electroacoustical translating means directly to the source, the second channel including a reverberation unit and amplifier coupled between the source and the electroacoustic translating means, means for controlling the intensity of the musical signals applied to both of the channels, and an impedance element having a relatively high poistive temperature coefficient of resistivity coupled to the second channel and responsive to the intensity of the signals applied to the second channel for causing the signals transmitted through the second channel and applied to its electroacoustic translating means to increase at a rate lower than the rate of increase in signals transmitted through the first channel and applied to its electroacoustic translating means.

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