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APPARATUS FOR IMPROVING SOUNDS OF MUSIC AND SPEECH

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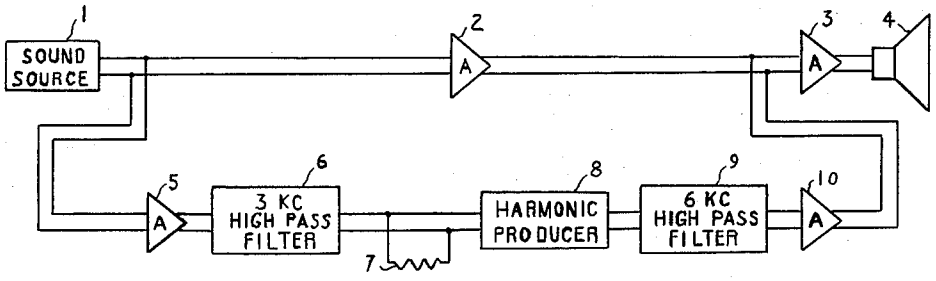

FIG. 1

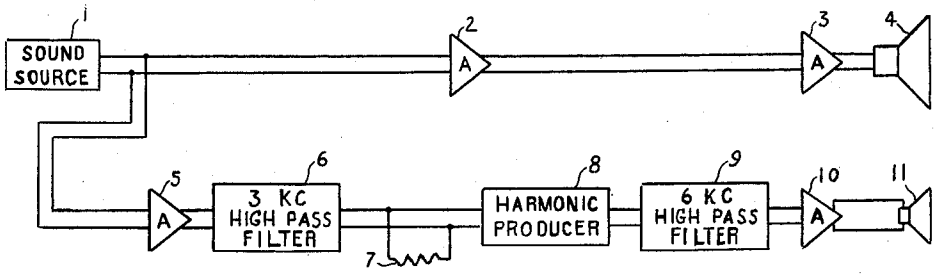

FIG. 2

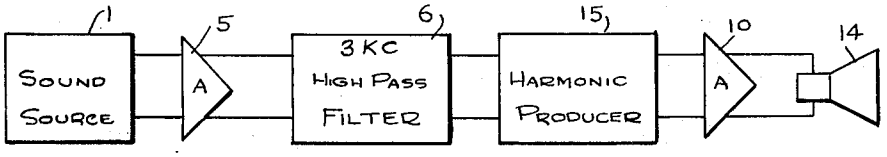

FIG. 3

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APPARATUS FOR IMPROVING SOUNDS OF MUSIC AND SPEECH

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3 Claims. (Cl. 179—1)

This invention relates to sound reproducing systems, sound reinforcing systems, music and speech, and specifically to apparatus for improving sounds of music and speech in which there is a deficiency of high frequencies received from the sound source. The improvement is made by producing harmonics of frequencies higher than 3 kc. in the sounds and producing sounds at frequencies higher than 6 kc. at a loudspeaker.

An object of this invention is to compensate for loss in sound at high frequencies due to the use of a narrow band of frequencies in a transmission system or due in part to the greater directivity of high frequencies in air relative to that at low frequencies, and in part to the greater absorption of sound in air at normal room temperature and humidity at high frequencies than at low frequencies.

Another object of this invention is to add high frequencies to only those sounds in music and speech for which added high frequencies are desirable.

Another object of this invention is to add high frequencies to sounds of music and speech with an economical arrangement of apparatus.

This invention has application in association with sound reproducing equipment and sound reinforcing equipment although when used with either equipment it is not necessarily electrically or mechanically connected thereto. It also has application in music and speech with which no sound reproducing or sound reinforcing equipment is used.

The novel features which I consider characteristic of my invention are set forth with particularly in the appended claims. The invention itself, however, will best be understood from the following description of specific embodiments when read in connection with the accompaying drawings in which,

Fig. 1 is a diagram of an arrangement in which low frequencies, mid-frequencies, and frequencies higher than 3 kc. of broadcast or recorded music or speech, or music or speech picked up at a microphone for reinforcement, are passed through a main circuit section and reproduced at a loudspeaker, and the frequencies higher than 3 kc. are also passed into a branch circuit section to a harmonic producer. Harmonics are produced at the harmonic producer and sound at frequencies high than 6 kc. is produced at the loudspeaker in the main circuit section.

Fig. 2 is a diagram of an arrangement in which low frequencies, mid-frequencies, and frequencies higher than 3 kc. of broadcast or recorded music or speech, or music or speech picked up at a microphone for reinforcement, are passed through a main circuit section and reproduced at a loudspeaker, and the frequencies higher than 3 kc. are also passed into a branch circuit section to a harmonic producer. Harmonics are produced at the harmonic producer and sound at frequencies higher than 6 kc. is produced at a separate loudspeaker.

Fig. 3 is a diagram of an arrangement in which frequencies higher than 3 kc. are received at a harmonic

producer from a sound source and sound at frequencies higher than 6 kc. is produced at a loudspeaker.

In Fig. 1 sound source 1 may be a microphone or an AM or FM radio tuner, or a magnetic sound head associated with magnetic tape, or an amplifier associated with a pickup for disk records. Currents from sound source 1 pass through amplifier 2 and power amplifier 3 to loudspeaker 4. Currents also pass through amplifier 5 and 3 kc. high pass filter 6, which is provided with impedance terminating resistance 7, to harmonic producer 8. At harmonic producer 8 second harmonics are produced which pass through 6 kc. high pass filter 9, amplifier 10, and power amplifier 3 to loudspeaker 4.

In Fig. 2 currents pass as in Fig. 1 except that the second harmonics which pass through 6 kc. high pass filter 9 and amplifier 10 pass to loudspeaker 11 instead of passing through power amplifier 3 to loudspeaker 4.

In Fig. 3 currents from sound source 1 pass through amplifier 5 and 3 kc. high pass filter 6 to harmonic producer 15. At harmonic producer 15 second harmonics are produced which pass through amplifier 10 to loudspeaker 14. Loudspeaker 14 differs from loudspeaker 11 in Fig. 2 in that it has a sufficiently poor characteristic at frequencies lower than 5 kc. so as to make the 6 kc. high pass filter 9 of Fig. 2 unnecessary. Harmonic producer 15 differs from harmonic producer 8 of Figs. 1 and 2 in that it has an input impedance to match the output impedance of 3 kc. high pass filter 6, whereas a high impedance is required at the input of harmonic producer 8 in Figs. 1 and 2.

Frequencies higher than 6 kc. which a listener hears with the use of either Fig. 1, 2, or 3, are not necessarily present in the music or speech at its origin, and if present their relative levels are ordinarily not the same. This invention is based upon the fact that listeners cannot discriminate between frequencies higher than approximately 5 kc. in music and speech and the same effect as produced by some frequencies higher than 5 kc. can be produced by the use of other frequencies higher than 5 kc.

Harmonic producer 8 in Figs. 1 and 2, and harmonic producer 15 in Fig. 3 may consist of a triode vacuum tube having high negative grid potential in a circuit similar to a conventional triode amplifier circuit. An output transformer may be used with some mis-match of impedance to place some inductive load on the tube. A filament type triode may be used, for example, which requires a 1.4 volt filament current, with 90 volts on the plate. Third and higher harmonics are produced but their levels are too low for them to be significant in this invention. The only effect of intermodulation at harmonic producers 8 and 15 is to add high frequencies when other high frequencies are produced.

Amplifiers 2, 5, 10, power amplifier 3 and harmonic producers 8 and 15 are required to be provided with gain controls at their inputs.

The output impedance of amplifier 5 is required to be suitable for connection to 3 kc. high pass filter 6. This filter may be of the interstage type and its attenuation may be 6 db at 3 kc. and 37 db at 2 kc.

The output impedance of harmonic producer 8 and the desired balance of sound of the added high frequen- required to be suitable for connection to 6 kc. high pass filter 9. The same input impedance of power amplifier 3 may be used in Figs. 1 and 2.

An example of the application of Fig. 3 is a violin solo which is played on the stage of a large concert hall and not broadcast, recorded, or sound reinforced. In this case sound source 1 in Fig. 3 is a microphone located near the violin. As frequencies in the order of 10 kc. are very directive the level of sound at these frequencies is much higher in one direction than in others,

Also, although absorption of high frequency sound in air is not excessive when temperature and humidity are not allowed for, it is excessive at normal room temperature and humidity. Consequently, when Fig. 3 is not used, some listeners at the sides and all listeners near the rear of the auditorium hear these frequencies at very low levels if they are not at such low levels that they cannot be heard. When Fig. 3 is used loudspeaker **14** can be directed either to nearby listeners who are out of the beam of the high frequencies or over the heads of nearby listeners to those at the rear of the auditorium. It is evident that two or more loudspeakers may be used if required.

The frequency range within which harmonics are required in Figs. 1, 2 and 3, is required to be of such width that sounds for which added high frequencies are desired have some significant partials within the range, and sounds for which added high frequencies are not desired have no significant partials within the range. These considerations place the lower frequency of the range at 3 kc. If no harmonics are produced in the 5 to 6 kc. range, this is not significant as the same effect can be produced by sound at frequencies higher than 6 kc. as at frequencies higher than 5 kc. because listeners have no pitch discrimination in music or speech at these high frequencies.

In order to place the arrangement shown in Fig. 1, for example, in operative condition the controls on amplifier **5** and harmonic producer **8** should be adjusted while having the control on amplifier **2** turned to zero, and the controls on amplifier **10** and power amplifier **3** turned up high. The music received from sound source **1** should be such that there would ordinarily be appreciable high frequencies at the point of origin of the sound. The controls on amplifier **5** and harmonic producer **8** should be adjusted so that there is no noticeable overload in the sound during the loudest passages of music. Overload can readily be detected by harshness of the hissing sound. When this is heard the controls should be turned down but only just sufficiently to result in smoothness of the sound. The control on amplifier **2** should then be turned up and the controls on amplifier **10** and power amplifier **3** readjusted as required to obtain the desired balance of sound of the added high frequencies relative to the normal reproduction of the sound through amplifier **2**. When the added high frequencies are at levels which are not sufficiently high they produce little or no effect. When at levels which are too high they distract attention from music or speech.

I desire to include within the scope of my invention all modifications and variations by which substantially the result of my invention may be obtained by the use of substantially the same or equivalent apparatus.

I claim:

1. Apparatus for producing harmonics of frequencies higher than 3 kc. in recorded music or speech and for producing sound at the frequencies of the harmonics, which includes a sound source, a harmonic producer which produces harmonics of currents received from said sound source, a filter for attenuating frequencies lower than 3 kc. to insignificant levels at the input of said harmonic producer, a filter for attenuating frequencies lower than 6 kc. at the output of said harmonic producer, an amplifier for amplifying said harmonics, and a loudspeaker at which sound at the frequencies of said harmonics is produced and at which said recorded music or speech is reproduced.

2. Apparatus for producing harmonics of frequencies higher than 3 kc. in recorded music or speech and for producing sound at the frequencies of the harmonics, which includes a sound source, a harmonic producer which produces harmonics of currents received from said sound source, a filter for attenuating frequencies lower than 3 kc. to insignificant levels at the input of said harmonic producer, a filter for attenuating frequencies lower than 6 kc. at the output of said harmonic producer, an amplifier for amplifying said harmonics, and a loudspeaker at which sound at the frequencies of said harmonics is produced other than that at which said recorded music or speech is reproduced.

3. Apparatus for producing harmonics of frequencies higher than 3 kc. in music or speech and for producing sound at the frequencies of the harmonics, which includes a sound source, a harmonic producer which produces harmonics of currents received from said sound source, a filter for attenuating frequencies lower than 3 kc. to insignificant levels at the input of said harmonic producer, an amplifier at the output of said harmonic producer for amplifying the harmonics, and a loudspeaker at which sound at the frequencies of the harmonics is produced, said loudspeaker providing sufficient discrimination against the frequencies upon which said harmonics are produced to bring them to insignificant levels.

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