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# AUDIO engineering society

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## Sound Reinforcing Systems

ARTHUR W. SCHNEIDER\*

A discussion of a variety of problems that arise in the installation of these systems in large halls.

**S**OUND REINFORCING is not, in the strict sense of the word, public address. It is an electro-acoustic system of amplifying and converting sounds into acoustic energy in such a fashion as to aid the original sound and to permit comfortable listening. A sound reinforcing system is not a reproducer of sound, nor is it a producer of sound. Fundamentally, the approach to a sound reinforcing system and the analysis of a sound reinforcing problem depends on sound reproducers and sound producers.

A sound reproducer is something which picks up a sound, amplifies it, and reproduces it so that the sound is as near to the original as possible. In this process no latitude should be taken by the engineer or the user to modify the original sound, even though this modification may make the sound more pleasing. In a case where latitude is taken to modify the nature of the original sound, then the instrument is no longer a reproducer of sound but becomes a producer of sound. For instance, Hammond organs and electric guitars are essentially producers of sound, whereas broadcast studios, transmitters, and radio receivers are essentially reproducing networks.

A sound reinforcing system, however, is neither one of these, but a combination of both in view of the fact that it is necessary to add to the original sound so that the original sound plus the amplified sound will make it sound to the auditor as if it were all original sound. Therefore, in the perfect sound reinforcing system, this blending of the amplified sound plus the original sound gives the auditor a feeling of comfortable listening without his realizing that amplification is being made.

From these statements it is readily

seen that the art of sound reinforcing is applicable primarily to large halls and outdoor places of entertainment. It is also interesting to note that the art of sound reinforcing is relatively young. It has originated since the advent of the microphone, loudspeaker, and amplifier. As a matter of fact, to the writer's knowledge, no outstanding installations of sound reinforcing systems were in use prior to 1931. Our forefathers were able to get around this fact by developing people with high acoustic output, and we cherish the memories of such producers of sound as Caruso and William Jennings Bryan. Now, through the efforts of sound engineers, we have developed a crop of singers who croon and politicians who whisper into KB2C's.

### System Requirements

Let us now consider the requirements of the so-called perfect sound reinforcing system, or at least the requirements of a system that would fill all the desired and ideal functions. The first requirement is for a system to amplify all sounds on the stage regardless of where these sounds originate, and to amplify them with sufficient intensity for the audience to hear comfortably before feedback occurs. Feedback, of course, occurs when the sound returning to the microphone from the loudspeaker is equal to the original sounds. The second requirement of the perfect sound reinforcing system is that all sounds be amplified and reproduced equally insofar as the frequency response is concerned. The third requirement is that the waveform characteristics of the sound be preserved, that is, that the reproduced sounds be relatively free from distortion. The fourth requirement is that the illusion be preserved. This, of course, is a most important factor when it comes to show business. The basic reason for people going to theaters is to lose them-

selves in the illusion of what is going on, and surely the illusion would not be preserved if the sounds appeared to come from any spot other than where they are produced. The last requirement of a sound reinforcing system—one without which an otherwise good system will cease to be good—concerns the acoustics of the hall in which the system is to be installed and the attention of the design engineer to these acoustic problems.

It is not possible to install a perfect sound reinforcing system for many reasons, and numerous compromises must be effected. In order to get sufficient amplification before feedback, the characteristics of the microphones should be such as to limit their range of pickup to the area in which the sounds are being produced. In general, directional microphones are needed with normal pickup from the stage side and little from the audience side. These go a long way toward increasing the maximum usable gain.

### Loudspeakers

On the speaker side, a directional unit is required so that the sounds produced can be directed into the audience area with a minimum of sound being returned to the microphone. However, a directional horn to cover the low end of the spectrum is impractical because of its size. Fortunately, this limitation is not serious in view of the fact that most sounds below 150 cps produced in the theater are of a sufficient intensity as not to require much sound reinforcing. Therefore, you will find that in most sound reinforcing systems the emphasis is laid on those frequencies extending upward from the fundamental of the male voice. At the high-frequency end of the spectrum, some compromises have to be effected in the loudspeaker design. Selection is limited, in view of the fact

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