THE PA BIBLE

ADDITION NUMBER FIFTEEN
BARRIER MIKING

INTRODUCTION

The use of microphones mounted on barriers, baffles, acoustic boundaries, floors, walls, ceilings, and other surfaces — even the human body — has grown in practice in live performance and recording. With proper application, barrier miking can help eliminate acoustic interference and enhance the reproduction of voices and instruments by augmenting microphone response.

When an omnidirectional microphone is placed near a sonically reflective surface, the sound received by the microphone no longer has any dual path effects and, as such, resembles a simple pressure wave. The microphone is in a "pressure zone." The term Pressure Zone Microphone (PZM™) has been used by Crown International to describe their microphone made for this purpose.

The effect of this placement on microphone performance is the elimination of dual path interference, an increase in the apparent microphone sensitivity and a change in the microphone's high-frequency response that is attributable to the "baffle effect."

One should not depend on this technique to improve the basic performance and quality of the microphone. Therefore, your first choice should be a high-performance microphone from companies like Electro-Voice, Shure Brothers, Beyer, etc.

In this edition of the PA Bible we will review how this practice was first applied, some of the more recent developments in the field, and some of the most asked questions regarding the application of this technique.

EARLY DISCOVERIES

About 1970, Electro-Voice engineers discovered a way of solving a miking problem commonly experienced in sound reinforcement and recording of stage performances.

The typical miking technique was to mount mics on stands along the front edge of the stage. However, this practice suffers from a phenomenon known as phase cancellation or "comb filtering." This is a form of acoustic distortion caused as a result of the sound waves from the same source arriving at the mic at different times. Figure 1 illustrates how this can happen. Notice that the sound waves from the singer travel to the microphone in two different routes. (A simple case, indeed!) The waves that travel directly to the mic are called "direct sound" waves. The ones that arrive after being reflected off the floor are called "reflected waves." In the sound system or on the tape, both sounds will be heard at different levels and at different times. Figure 2 illustrates the results of this graphically. Note the deep dips where the sound waves perfectly cancel each other; thus the term, "comb filtering." This was the problem that EV engineers set out to solve.

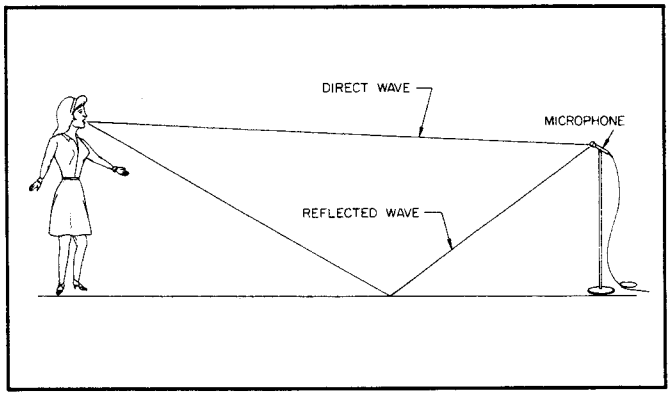

FIGURE 1
Typical Distance Miking

SOLVING THE PROBLEM

An understanding of the principles of barrier miking can be gained from studying some of the acoustic fundamentals that EV engineers employed.

In the case of microphone phase cancellation, the frequencies where cancellation occurs and the amount of cancellation is dependent upon the relative positions of the source, the microphone, and the reflective surface.

Look at Figure 1 again and notice that if the microphone is lowered closer to the floor (the reflective surface) the direct path and the reflected path become closer to the same length. As the two paths approach the same length, the distortion caused by the comb effect is audibly reduced.

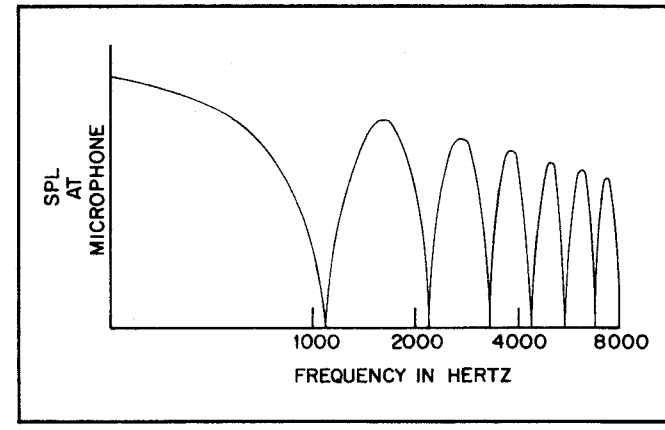

FIGURE 2
Comb Filter Effect

It was finally discovered that the closer the reflective surface was to the mic, the higher the frequency of the first dip (see Figure 3). Note that when the mic and the reflective surface are very close together, the dip will occur well above the audio range. The decision was then made to mount the mics on the stage floor, and the EV Mike Mouse was developed for convenient floor positioning (see Figure 5). This low-profile, Acoustifoam™ block not only uses reflected sound to increase gain before feedback, but also reduces interference resulting from floor reflections. Many types of microphones may be used with the EV Mike Mouse. A tripod microphone holder for floor positioning is available from Shure.

FURTHER DEVELOPMENTS

In recent years, this principle has been employed with very small microphones such as the EV CO94, the Crown PZM, and the Shure SM18. The fact that these types of mics are small not only allows their use inside instruments such as pianos, but they can be placed even closer to the reflective surface, thus assuring an in-phase arrival of the direct and reflected sounds at high frequencies.

COMMON QUESTIONS

Electro-Voice receives numerous questions regarding the use of microphones mounted on barriers, baffles, acoustic boundaries, floors, walls, and ceilings. Following are some of the most common questions and our answers.

WHAT IS BARRIER MIKING?

Barrier miking, also referred to as proximity mounting, is the technique of mounting a microphone on or very near an acoustically reflective surface. Laying an EV CO94 or a PL4 microphone in a model 370 Barrier Plate in the center of a conference table is an example of barrier miking.

A word of caution, barrier miking is not a "cure-all" and there is no "magic" in barrier miking. Each miking situation must be analyzed individually.

WHEN SHOULD BARRIER MIKING BE CONSIDERED?

Barrier miking should be considered: (1) when the situation requires relatively distant miking, and/or (2) when low visibility of the microphone is required, and (3) because mics used in barrier miking tend to be small, they should be considered for use inside instruments such as pianos.

The principal advantage of barrier miking is the elimination of a portion of the destructive interference that results from the presence of a reflected wave that is equal or nearing equal in strength to the direct wave but that has a slightly longer path length. This is, of course, the situation that results when distant miking is used. (See Figure 1)

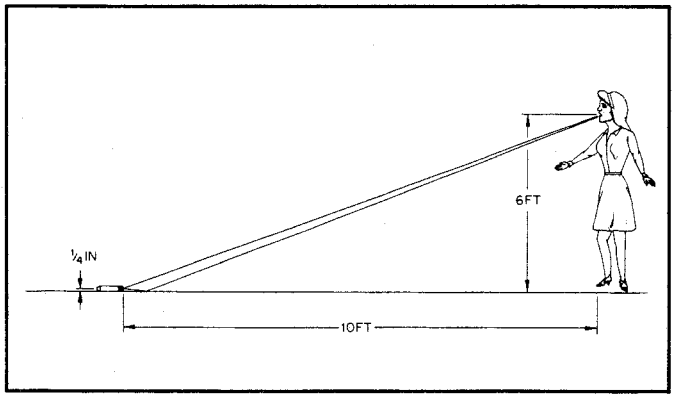

FIGURE 3
Time Delay

The visibility and size advantages are obvious. Barrier miking allows the microphone silhouette to blend into the podium, floor, wall, or instrument. In addition, the size advantage allows the body of an instrument to act as the barrier.

WHAT ARE SOME TYPICAL INSTRUMENT MIKING APPLICATIONS?

Barrier miking offers the user a means to express artistic freedom by using the influence a barrier and position can have on the resulting sonic character of the microphone's output. In instrument applications, a barrier microphone can be placed within the instrument and, through positioning, the sonic character adjusted to the user's preference.

Piano Miking

The piano is one of the most difficult instruments to mic successfully. Its large size and large number of discrete desirable sonic sources make it very hard to achieve the proper mix of these sounds. Many users have found they can obtain a very clean and well-balanced sound from a carefully positioned microphone mounted on the piano's sound board.

In situations requiring a well-balanced piano and good gain-before-feedback, some users have been able to locate a barrier microphone within a piano with a closed sound board. The resulting attenuation of room noise combined with the increased piano loudness can produce very good gain-before-feedback relative to one or more conventional microphones placed some distance from the piano. Since the "best" locations vary and depend to a great extent on the desired character, trial placement should be done carefully. Moving the unit a few inches on the piano's sound board can have a profound effect on the resulting sonic character and balance.

Drum Miking

Placing a small microphone against the inside surface of the drum's side wall can provide a very clean sound and, being within the drum, the resulting intensity, relative to the room, gives very good gain-before-feedack. As was mentioned in the piano section, exact placement will vary due to differences in drum design and user sonic preferences.

Miking Stringed Instruments

A barrier microphone can be mounted either on or inside a stringed instrument. By positioning the microphone carefully, the desired balance can be obtained.

Normally, the user must employ electronic equalizers to obtain frequency response other than that provided by the microphone's native response. By mounting a barrier microphone on relatively small surfaces, the user can create a sonic diffraction surface capable of changing the microphone's manifest frequency response.

Through experimentation the user may be able to create the desired sonic effect. Since small baffles also impart directional effects that are frequency dependent, this technique can produce sonic characteristics that are virtually impossible to obtain by any other means, including the use of expensive equalizers.

I'VE HEARD THAT A MICROPHONE MOUNTED ON A BARRIER IS MORE SENSITIVE THAN THE SAME MICROPHONE MOUNTED ON A STAND. HOW IS THAT POSSIBLE?

When the sound wave reflected from the barrier and the direct sound wave arrive at the microphone in the same relation, the two waves are added together, resulting in a microphone output that can be twice that of the direct wave, a gain of 6 dB.

WHAT EFFECT DOES CARPETING HAVE ON THE PERFORMANCE OF A BARRIER-MOUNTED MICROPHONE?

Since the strength of the reflected wave determines the additional

sensitivity, anything that reduces the reflected wave energy will reduce the sensitivity of the microphone. Carpeting or acoustic tiles tend to reduce the intensity of the higher frequencies; therefore, the output from a barrier microphone on a carpeted floor will have a marked reduction of high-frequency sensitivity.

I'VE READ ABOUT USING PLEXIGLASS AND PLYWOOD PANELS TO IMPROVE MIC PERFORMANCE

The basic idea is to use deliberately placed reflecting surfaces to block unwanted sounds and/or reinforce, via the resulting reflections, the desired sounds. If the baffles used are big enough to reflect sufficiently low frequencies (to reflect sound, a surface must be big in relation to the wavelength of the sound) and are carefully arranged, then a very effective miking situation can result. This technique has often been used in miking singing groups such as choirs. When several panels are used to form a corner or pyramid shaped assembly, a crude "horn" is created and the resulting directional and frequency characteristics are very complex. The gain can greatly exceed the coupling associated with a simple single-surface reflector, and the resulting response variations are also exaggerated.

WHAT TYPE OF MICROPHONES CAN BE USED IN BARRIER MIKING?

The majority of the microphones in use as barrier microphones are small, omnidirectional electret condenser microphones such as EV's PL4. These units can be placed close enough to the barrier to assure an in-phase arrival of the reflected sound at high frequencies. The omnidirectional pattern can also be of use when complex reflectors are used, since omnidirectional microphones possess no directionality of their own and are predictable.

Recently, a number of manufacturers have developed barrier-mounted microphones based on directional transducers. These offer the additional advantage of directionality which can significantly improve gain-before-feedback.

Electro-Voice manufactures two accessories that are applicable to barrier miking: the model 370 Barrier Plate (Figure 4), suitable for mounting a lavalier microphone to a table top, wall, ceiling or instrument and the model 411 "Mike Mouse" (Figure 5), especially suitable for stage floor use.

We hope this addition to the P.A. Bible has contributed to your understanding of barrier miking. If you have further questions about appropriate applications or proper techniques for barrier miking, Joe Katowich, EV's Technical Communicator, will be happy to answer them.

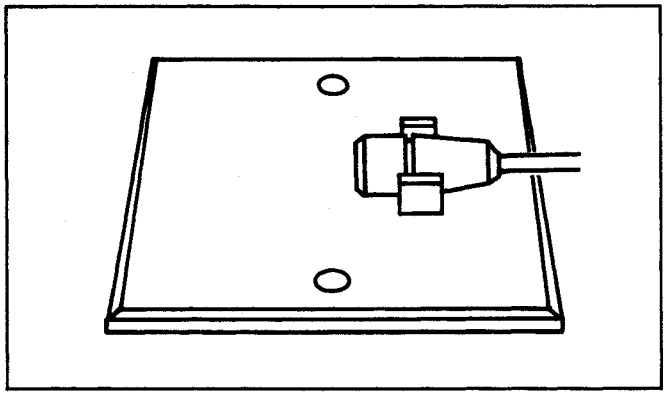

FIGURE 4
Small Omni Attached to a Barrier Adapter Plate

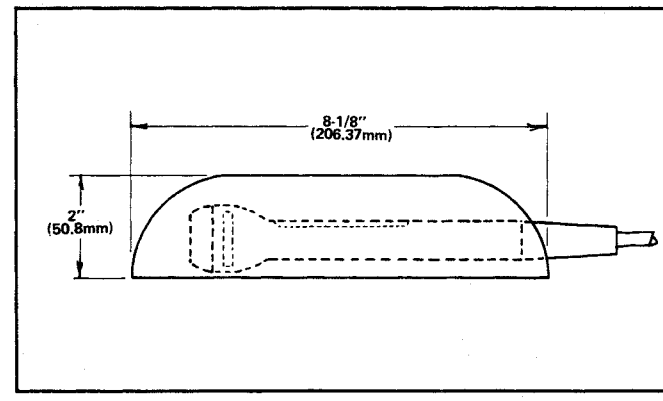

FIGURE 5
Cardioid Microphone in a Mike Mouse

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