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A Distant Micing Technique

Here is a study of a microphone placement technique which some engineers have already discovered but not fully utilized.

DURING an investigation of distant microphone pickup techniques, we were comparing two tape tracks recorded from the same source, one recorded at a near distance of one foot and the other at a far distance of fifteen feet. Compared to the near recording, the distant recording had a hollow quality, somewhat like short-wave reception when the signal is fading.

Another experiment pinpointed the cause of this effect. Here the distant microphone was moved vertically from a six-foot altitude down to the floor, keeping the source distance constant at twelve feet. Now the hollow effect varied in pitch, becoming higher until it vanished as the microphone approached the floor closely. With the microphone barely off the floor, excellent results were produced. The only difference between the near and far recordings was the greater reverberation and lower level in the far recording, as expected.

The explanation of this effect may be seen in *Figure 1*. Here a sound source (performer or musical instrument) is located four feet above the floor. The microphone is located twelve feet away on a floor stand, also four feet high. This arrangement might be used with a chorus or orchestra to maintain balance between performers and capture some natural reverberation; or in a singing/dancing routine where the stage area must remain clear.

The direct sound travels twelve feet; however a considerable amount of sound is reflected from the floor and up to the microphone again. This reflected sound travels a total of 14.4 feet, which is 2.4 feet farther than

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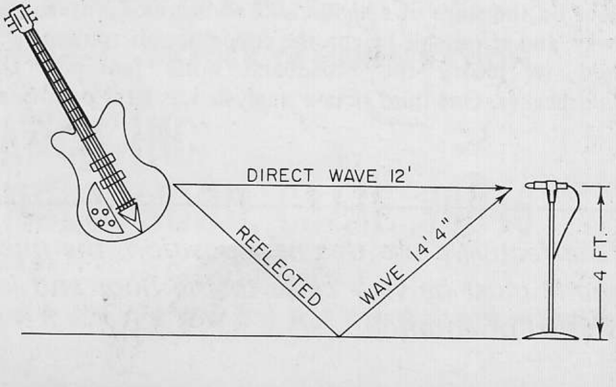
Figure 1. The explanation of the quality change effect caused by moving the microphone vertically.



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the direct sound. At a frequency of 233 Hz (wavelength 4.8 feet) the reflected sound will be 180 degrees out of phase with the direct sound, producing the phase cancellation effects associated with misaligned tape recorders or multiple microphones. This cancellation will also take place at all odd multiples of 233 Hz; *i.e.*, 699, 1165, 1631, 2097, etc. Actually, the cancellation is not complete because the reflected sound pressure is less than the direct sound pressure due to its longer travel and imperfect reflection. This is still sufficient to produce 15 dB dips in the response!

An objective experiment to document the effect was performed in an anechoic chamber. The results are shown in *Figure 2*. A one-inch condenser microphone and loudspeaker were set up four feet above the non-reflective mesh floor, separated by a distance of twelve feet. The resulting sound field experienced by the microphone is shown as curve (A). Next, a 4 x 12-foot sheet of plywood was placed on the mesh floor, between the microphone and source. Curve (B) is the result. The interference effects are quite noticeable. Curve (C) shows the result of a computer simulation of the setup, assuming 100 per cent reflection from the floor. The similarity of curves (B) and (C) show that the effect is real and predictable. The differences are due to the restricted size of the "floor" employed, and the absorption of the wood at higher frequencies.

The microphone was then lowered until it was barely clearing the floor. Curve (D) is the result, showing that the irregularities have disappeared and the level has nearly doubled. The high frequency roll-off occurs because the center of the microphone is still above the floor level.

An easy way of visualizing and explaining the situation is shown in *Figure 3*. Here, the floor has been removed and a mirror-image "virtual" source introduced which emits sound waves identical to the original source. A microphone located at A will receive the two sound waves somewhat out of step because the path lengths are not the same; consequently, interference effects will be produced. The only locations which are free of these effects lie along the perpendicular bisector of the line joining the two sources. Any point on this line will be equally distant from the two sources, and the two sounds will be exactly in phase. This line corresponds to the floor line in the real situation. Of course we cannot semi-sink the microphone into the floor, but using 1/16 or 1/8 inch clearance will insure that the lowest frequency cancellation is above 10 kHz.

To demonstrate the effect of a real, not anechoic, environment, a sound source was set up 53 inches above the floor on the stage of a high-school auditorium. Fifteen feet away, and at variable height, the condenser microphone was used to record the broadband noise fed into the loudspeaker. One-third octave analysis was later performed

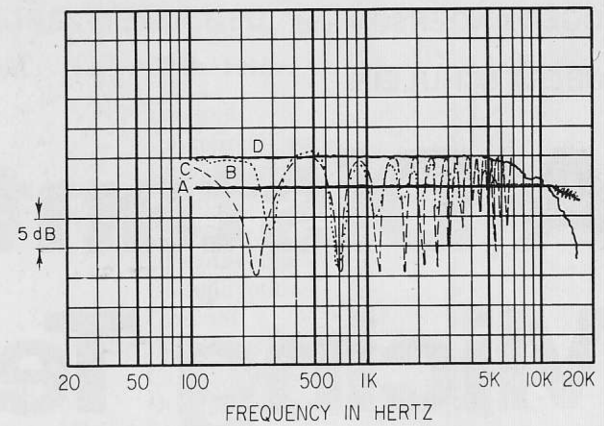


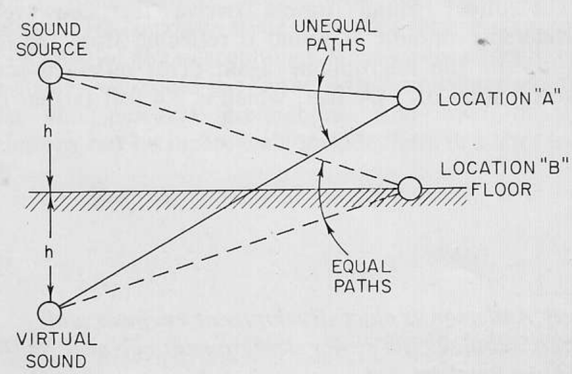
Figure 2. Anechoic chamber tests. At (A) we see the original sound field without a floor. (B) shows a 4- x 12-foot floor added. (C) is a computor simulation of (B). (D) is the microphone at floor level.

to yield the families of curves in *Figure 4*. The one-inch curve is similar to the response of the source measured in an anechoic chamber, and is the basis of comparison to the other curves. The two-inch curve shows a serious loss around 6 kHz. At twelve-inch spacing, the "hole" has moved down to 1 kHz, and some near relatives have appeared at 3 and 5 kHz. At the usual height of 53 inches, a serious dip occurs at 230 Hz, and even at 144 inches on an overhead boom some loss may be noticeable. The strong smoothing and averaging effect of 1/3-octave analysis makes the nulls less drastic than the sine-wave measurements, but they still are quite apparent.

Tests performed with unidirectional microphones have shown the same type of response-perturbation which the omnidirectionals exhibit. A unidirectional microphone used on the floor will retain most of its polar discrimination. Of course, when the microphone is close to the source, the intensity of the reflected sound is too small to have much effect, even though the path length is vastly different. In addition, the polar pattern of directional microphones will afford useful discrimination against floor reflections. If the floor is carpeted, the effects of reflection will also be reduced.

To effectively use this new position, the microphone must be very close to the floor and in a parallel orientation. The use of a desk stand places the microphone too high, or at an unfortunate angle to the floor. Overhanging the microphone head on the edge of a foam block is

Figure 3. A visualization of the effects described.



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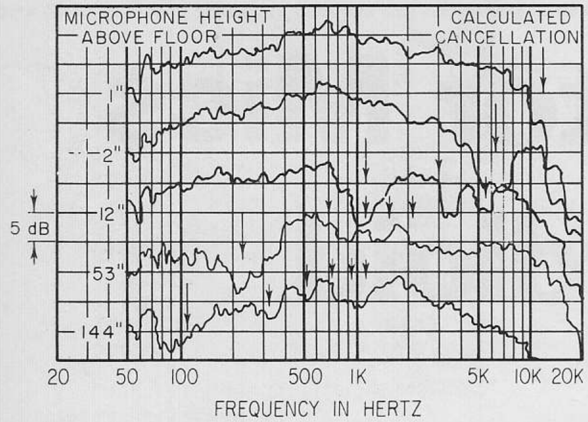

Figure 4. On-location tests. The curves have been displaced on this graph for clarity.

acoustically usable, but mechanically unstable.

A practical solution to the problem is shown in *Figure 5*. This new stand has been designed to support the microphone properly and securely. In addition, it affords excellent shock isolation from floor vibrations. It is available in two models, the S53P and S55P, to fit 0.790 or one-inch diameter microphones respectively, and folds flat for storage.

Once the possibilities of reflections are recognized, other applications come to mind. For instance, a recording made at a desk from one or two feet away with the usual desk microphone stand will show the same type of interference effects noticed at greater distances. Similarly, when recording in auditoriums, putting microphones next to the side walls may be desirable. Many other examples will be apparent if the principle is kept in mind.

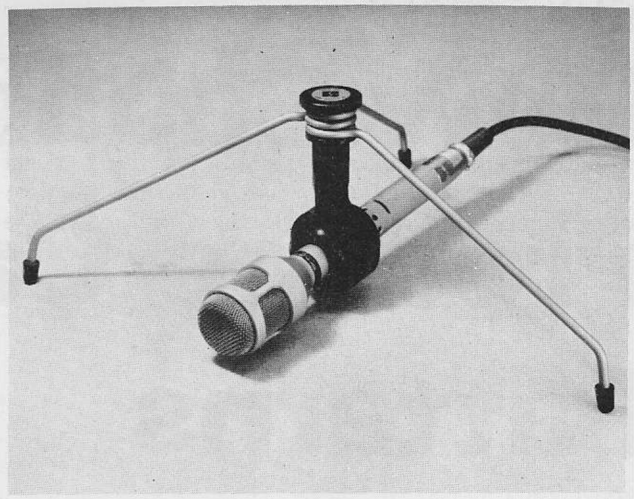

Figure 5. The mic stand that has been devised to take full advantage of the conditions described. It is commercially available from Shure.

Our experiments have led to this general rule: *When the microphone-to-source distance becomes greater than one or two times the distance from the source to the reflecting surface, it is desirable to place the microphone next to the reflector.*

As a bonus, the sound level will be 6-dB higher than if the reflecting surface was not present. ■