NORMAN S. CROWHURST

db Theory & Practice

Authentic Reproduction

• Last month, under the heading *Faithful Reproduction,* I discussed different views that have developed over the years about what that means. In this context, *faithful* conveys the thought of accurate, flawless. From the discussion last month, it becomes apparent that perfect accuracy of audio reproduction is an impossibility, using any method.

The word *authentic* means convincing, capable of being believed, or genuine. What reproduction has to do is to convince our ears, or more accurately, our hearing faculty, that we are listening to the real thing. Last month's discussion should have convinced you that you cannot ignore the environment in which you want the reproduction to do its convincing.

So let us now turn to how you can go about creating a pleasing result in different environments. In every instance, first you must consider how you normally listen in that situation. In some instances, you may wish to change the environment to some extent, but usually people just want to buy a hi-fi, a stereo or a quad that will do what they want, in their room as it exists.

Let us take the easy settings first. In a well furnished room that is acoustically relatively "dead," you listen in a relaxed manner. Unless you are hard of hearing, you never have to strain to hear, or understand, what someone says in such a room. The background is quiet and whatever you want to hear comes to you unconfused—directly. Listening is a pleasure.

This is the room in which the idealized "faithful" reproduction comes nearest to being fulfilled. So to serve this room, you want sound sources—loudspeakers—that serve you directly. All the frequencies present in each channel of sound should radiate uniformly from an appropriately placed loudspeaker so that a listener in any part of the room gets a correct perception of the stereophonic nature of the original source to which he is listening.

If the room happens to be extra absorptive of the higher frequencies, you may want to use tone control, or equalization, to give this part of the spectrum a little extra emphasis. But this type of room should not present any problems in producing what we could call authentic reproduction.

Now let us turn to the difficult environments. In the larger variety of rooms, usually called auditoria—but they are rooms just the same—the sound man has always had problems. Modern technology has enabled him to solve them a little better. But how does he do it?

COLUMN LOUDSPEAKER

One of his best tools is the column loudspeaker unit. What does that do? Its main function is to put sound where you want it, which is where people are listening, and to avoid putting it where it is not wanted, which is where it would create undesirable reflections and their attendant confusion.

So you have the high school gym or the local armory hall with its lofty ceiling from which echoes of the original sound come bouncing down, after noticeable delay, to cause confusion. Of course, that's what makes the room sound like a gym, or an armory. But it also makes listening, especially to speech, very difficult.

If you listen to Stan Kenton playing at the local armory, then the sound is real: Stan Kenton's band, playing at the local armory. It does not need reinforcing, because Stan's band has plenty of acoustic output without artificial help. But when Stan steps forward to tell the audience something about the last number or the next number, the audience wants to hear what Stan says. They do not want to

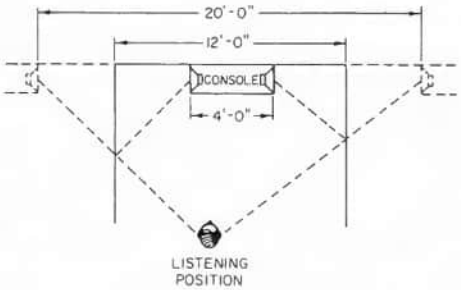

Figure 1. Reflective wall surfaces can be utilized rather than having to fight them. The actual distance between the left and right speakers is only 4 feet. The apparent distance between them, as perceived by the listener, is 20 feet.

hear his voice bouncing unintelligibly round the walls.

This is where the column speaker units are useful. By installing them where they direct sound at the audience seating and avoid shooting it at that lofty ceiling, they make possible a much more intelligible sound, at least. People like Stan, who perform on the road in a different auditorium every night or two, carry their own system with them.

They use column speakers, not because they are more convenient to tote, but because they do the job better, in the average difficult room. Stan's sound boys set them up, looking at the audience area to see that the audience gets served, and that the ceiling does not.

SMALLER ROOM

How does this apply to your much smaller room at home? If it is highly reflective, maybe column speakers could help you too. But there are other tricks of the trade that can sometimes help in the smaller, over-reflective, type of room.

What we have been emphasizing is that however you introduce the sound into the room by means of your loudspeaker installation, your hearing is already conscious of the room environment. As the old saying goes, "If you can't beat 'em, join 'em." And this certainly applies to acoustic environment.

One of the early console stereo arrangements did this, perhaps without realizing it, as far as the designer was concerned. The designer put the loudspeakers in the ends of the cabinet, so as to make a package that gave the "biggest possible" stereo—in terms of separation—in the smallest possible package.

But put this package in the middle of one of the shorter sides of a rectangular, highly reflecting room, and what do you have? Sound from the speakers on the ends goes out, hits the longer side walls and is bounced back in toward the listeners. What this does is to create image sources for the sound, beyond the walls. If the wall against which you put the console is 12 feet long, and the console is 4 feet, then the speakers are each 4 feet from the wall they face.

This means the image sources are 20 feet apart, along this 12 foot wall. This arrangement suits such a room because the reflections normal to that room make it seem bigger than it really is, anyway. Our hearing faculty judges the size of a room by its reverberation time. Reflecting surfaces increase reverberation, and thus reverberation time, making the room seem larger than it really is.

So that method uses a characteristic of the room, its reflections, instead of trying to fight them. The result is natural for that room, far more natural in fact than putting separate loudspeakers in the corners, although that may not have been what the designer had in mind when he put together that design.

That is one way to go. Another approach uses a different characteristic of such a room, its size. The way we just described uses the reflections that

make it seem bigger than it really is, to expand the apparent sound source. The alternative is to work on the directness of the wave—or rather, its apparent directness.

This emphasizes that, whatever we do, we are creating an "authentic" illusion. The problem in any room that has too much reflection is that indirect sounds confuse the direct sound. So if only we can direct the sounds at the listener and avoid the reflections, or at least minimize them, we will have it made—right?

Perhaps, if the listener would oblige by sitting in that one "ideal" spot that early stereo experimenters insisted upon. But most people want to sit where they like, not to be dictated to by an inanimate object. If we try to direct sound at every possible position where a person might sit, we find ourselves fighting reflections again because sounds that do not "find" a listener to absorb them, continue to be bounced around by the reflecting surfaces.

ISOPHONIC STEREO

Back in the early days of stereo, CBS Labs developed a system that they called "isophonic." That particular system used a single channel for the lowest frequencies, up to about 250 hertz, and separate channels for frequencies above that. The stereo illusion was due to the way those separate channels were used.

Instead of employing ordinary loudspeakers, the ones used had open backs, and their positioning was important. The technical papers that CBS presented on the subject explained how such a system produced a "correct" sound field for proper stereo separation around each listener's head. Let us explain that a little more fully; the reason this system never caught on more than it did, I believe, is because people just did not understand it.

Any sound man knows about ordinary phasing problems. If you apply monophonic program to two loudspeakers, spaced apart, and you occupy a suitable position, the sound will appear to come from midway between them. If you move your position, the apparent source will change. That fact was an early criticism of stereo. But let us not stop there.

If, while you stay in the position where the sound seems to come from midway, you reverse the phase of the sound fed to one of the loudspeakers, something peculiar happens. Now the sound no longer comes from in front, but its source seems to "get lost." If you now move around, as you get closer to one or the other speaker, the sound will seem to come from the nearest one.

That is using two loudspeakers, radiating out of phase. The open back loudspeaker is a single unit, radiating out of phase from front and back. So the sound field it creates in the vicinity of a listener's head is somewhat like that produced by two loudspeakers out of phase. But it is different because now the out-of-phase sources are close together, not widely separated, which means that the effect the double source produces is not confined to the special spot we discussed, relative to the widely separated case.

That is half the story. The other half is putting another such unit on the other stereo channel. Now the combined field from both of these dipole units creates a sound field around the listener's head that is a composite of that radiated by the individual units. It can and does create stereo separation at the listener's head.

It plays down reflected sound because this complex sound field is far stronger, to the listener, than all the confusion that develops a few milliseconds later. It is a completely different way of getting the desired authentic effect.

One argument used against the CBS system was that stereo separation disappeared below 250 hertz, or whatever crossover frequency was used for that purpose. That was a purely theoretical argument, with no foundation in practice. The fact is, in any room of the size in which such a system would be used, stereo separation of those low frequencies is impossible anyway.

The sense of location for instruments that include those low frequencies is not due to those frequencies at all. Try it, with string bass reproduction, for example. CBS demonstrated it with that kind of program, but not enough people listened to the demonstration. The overtones gave the sense of location and the low frequency part was convincingly—authentically—conveyed as being where the rest of the sound appeared to come from.

You do not have to get a CBS isophonic to do that job. Any open-backed loudspeaker can be used in the same way—or rather, a pair of them.

And what about quad? This would be interesting to pursue. The main purpose of the "rear" speakers is to reproduce ambience. This changes our expectations of them. Before quad was introduced, some experimented with creating artificial ambience, by feeding delayed signal to the front units (since that is all there was) out of phase. It was more convincing than you would expect. ■