Stereo News

TWEETERS AND WOOFERS AND STEREO SOUND

■ The speakers in a stereo high fidelity system have to do an almost impossible job. A 12-inch (or so) cone of specially treated paper is expected to reproduce sound that was produced by anywhere from one piano to a 110-piece symphony orchestra.

Because of these great demands, loudspeakers are often regarded by engineers as the weakest link in the reproducing chain. They are the components that very most widely in quality and price from one make to another.

A recent count showed more than 300 different loudspeaker models available. They ranged in size from huge woofers more than 15 inches in diameter, which reproduce only the bass notes, up to tiny tweeters whose cones are less than two inches across.

These driver units include only the heavy magnet structure, the cone or diaphragm, and a metal supporting structure. A complete speaker system includes the box and baffle, or enclosure, as well as one or more drivers. The enclosure is necessary for reproduction of bass notes. Enclosures will be discussed in detail in a later article.

When the cone of a woofer speaker moves back and forth, it creates sound by pushing air—making sound pressure waves in front of the speaker and behind it.

These front waves and back waves must be kept separated by the baffle, or enclosure. If they are not kept apart. the sound pressures in the lower frequencies from the back and front will cancel each other out,

This photo shows how a smaller speaker system may be added for the second stereo channel when one already has a large monophonic speaker setup. At right is the original, elaborate three-way speaker. It contains a heavy cone woofer in addition to a mid-range horn and tweeter. At the lower left is the much smaller Stereon speaker, made by E-V for add-on stereo. Above it is a cut-away view of the inside of the Stereon. The arrows point to tweeter (above) and mid-range horn (lower). These two units match the drivers of the original system.

and the base notes will not be heard. No enclosure is needed for tweeters, though they often are placed in the bass baffle for convenience.

The woofer has a paper cone diaphragm eight, 10, 12, or occasionally 15 inches in diameter. It reproduces notes from the lowest frequencies, 35 or 40 cycles a second, to between 350 and 1,000 cycles. Tweeters cover the range between 800 and 3,500 cycles a second up to 10,000 or 20,000 cycles.

If there is a midrange unit, it may go as low as 300 cycles or sometimes as high as 5,000 cycles. Tweeters and midrange drivers may be small paper cone speakers from two to five inches in size. Alternately, they are often small metal horns with the diaphragms small metal or phenolic.

When a speaker system covers the entire range of sound frequencies with two or three different drivers, it also includes a crossover network.

This unit, connected between the amplifier and the drivers, send the low notes to the woofer and the high notes to the tweeter (s). Crossover networks are compact, clearly marked, and easy to install. They

have simple screw terminals, like the terminals on the speakers themselves.

Today, any loudspeaker will work with any modern amplifier. Both speakers and amplifiers have screw terminals marked four, eight, or 16 ohms. Amplifiers have two or three alternate sets of terminals, so they may be matched to whatever value has been chosen by the speaker maker.

Connections may be made using any ordinary wire with two conductors. Most convenient is regular electric lamp cord. Also useful, especially for passing under a rug is the flat cable used for hooking up FM tuners and television set antennas. This is called 300-ohm, or television, lead-in wire.

"What speakers should I add to my setup to make it right for stereo?" is a common question nowadays.

The two answers are (a) get another identical speaker setup, no matter how elaborate your original system is, or (b) it doesn't matter much what you get, since only the treble range is needed for the second stereo channel. Of course, the truth lies between these extremes.

If space and cost are no problem, then (a) is certainly the answer. But if you have a very fine system for monophonic listening, you usually can get excellent results with a less-expensive second channel.

With a big two- or three-way system in use already, try to get a second setup whose treble sound is similar to that of your main system. Bass tones have less directionality than the midrange and treble. Many makers of big systems, notably University, Stephens, and Electro-Voice, make use of this fact. They have add-on units that reproduce mostly the treble notes for one or both stereo channels, while the lows come from the same woofer. The owner of speakers made by one of these companies should investigate adding another of their units.

If you already have a small, high-quality unit using a special cabinet, such as the R-J, AR, or KLH systems, an ideal solution is to match your present monophonic setup. Or if necessary, use a smaller similar model made by the same manufacturer.

There used to be a rule of thumb about the size of a speaker system: "The bigger the box, the better the bass."

This is a typical modern compact speaker system. Suitable for either bookshelf or floor use, this is the KLH acoustic suspension Model Six, priced at $125.

Thus, the best high fidelity systems had huge speaker cabinets. Many speakers were mounted in closet doors making the whole closet an enclosure. This is still a good idea if you have a heavy door and there isn't any noticeable space around its edges when it's closed. Some persons even mounted woofers in a ceiling or wall, making an attic or another room serve as the enclosure.

But today excellent bass reproduction can be had from much smaller enclosures. Usually, though, best results come only when the exact cabinet or enclosure designed for a particular speaker driver is used.

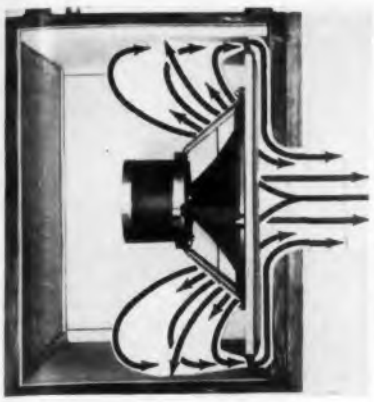
The first small loudspeaker to be sold widely was the R-J, invented by cartoonist Frank Robbins and engineer Bill Joseph. Still very popular, it delivers good bass at relatively low cost.

The R-J enclosure works well with any of a variety of driver units. There were many copies of the R-J, mostly pirated versions. Some worked well; others were little better than plain small boxes.

The bass reflex cabinet, in which apart of the back wave of a speaker is allowed to come out the front (or bottom) of the cabinet to reinforce the front wave at some fairly low bass frequencies, is inexpensive, and many persons find it produces good bass.

There are many variations of the bass reflex principle, which has been commonly acknowledged since the 1930s, when the Jensen company of Chicago started producing it in quantity. Jensen is today one of the best-known makers of high fidelity drivers and cabinets.

A major advance in loudspeaker art was made a few years ago when a young lecturer at New York Uni-



This is an internal view of the R-J compact speaker enclosure. The back waves go around a special baffle designed so they add front wave bass notes. Any heavy duty driver may be used.

versity, Edgar Villchur, developed a principle called acoustic suspension.

This was a major technological breakthrough, and the success of the company he later formed to make speakers attests to the soundness of his theory. In the acoustic suspension system, a particularly floppy woofer cone is used, along with a small but very heavily built sealed cabinet of critical volume. The air in the cabinet acts as a substitute for the mechanical spring (spider) usually employed at the voice coil of the driver.

Because their cabinet design is so critical, Acoustic Research sells speakers only as complete units. Similar excellent units are made by KLH, an offshoot of Acoustic Research, which makes its speakers under license from Acoustic Research.

KLH has developed its own manufacturing methods and drivers but uses the same engineering principle. Persons who have compared the speakers made by these two companies say that they sound slightly different, but that either provides superior sound in small space.

Bear in mind that acoustic suspension speakers need more power to provide the same sound output as other higher efficiency speakers. In other words, if you customarily like to fill a large room with music at high sound levels, an AR or KLH speaker setup would require amplifiers capable of supplying perhaps 20 watts (rated) where University, Jensen, Altec, and other similar units would produce as much sound from say, 12- or 14-watt amplifiers.

Another interesting solution to the second channel speaker question comes from Jensen, with its stereo director unit. This is a full-range, three-way unit with the woofer

speaker in a good-sized cabinet and the midrange and treble units on top of that cabinet, available for pointing anywhere in the room. This allows easy shifting of the stereo coverage area. The Jensen Stereo Director SS-100, three-speaker system in a wood cabinet costs $180.

How much will loudspeakers cost?

Complete unit range up from the $29.95 Telematic, a surprisingly good speaker at that money. The sky is the limit. Typical medium-priced speakers cost between $80 and $150 dollars, and some in this range will provide fine sound.

At the high end of the scale the Klipshorn, costing $700 to $800, is joined by a number of huge Electro-Voice and J.B. Lansing units, which range up to the JBL stereo speaker called the Paragon. This nine-foot-long unit is by far the best of the two-in-one stereo speaker systems and one of the best of any sort. It costs $1,830.

In assembling a monophonic system, a useful rule for speaker cost is one-half to one-third the total system's cost if the speaker enclosure is included. In stereo the ratio may run about the same, making some allowance if there is fancy cabinetwork and wood finishing involved.

The most perplexing problem in stereo (beyond paying for the equipment) is usually where to place the speakers. This is because the stereo effect is lost unless one sits somewhere nearly equidistant from each speaker and neither too close nor too far away from both.

The general rule is to separate the two channels by about eight to 11 feet and to sit about eight to 15 feet away from them. In practice these dimensions will vary considerably, but these are good distances to start with. Try one setup for two days and then change the distances, change the angles of the speakers and try the new arrangement for at least two days.

Today one hears much about electrostatic speakers. Generally, these are only for the middle and high range, though a few full-range units have been made. With one notable exception, good electrostatic tweeters are very expensive, costing at least about $100.

The exception is an imported unit that costs only $30 and is sold in this country by the Audio Shack Corp., 167 Washington St., Boston, Mass. This excellent tweeter is particularly well suited for use with woofers of the acoustic suspension type. It points the way to improved electrostatic units at lower prices.