Richard Vandersteen: Keep on Truckin'

Ken Kessler | Dec 31, 2005 | First Published: Jul 1, 1988

Richard Vandersteen doesn't look like a typical loudspeaker designer. True, he wears glasses, but his presence suggests a longshoreman or somebody who'd be played by Gene Hackman. And sure enough, he tells you in a quasi-Dukes of Hazzard drawl that he's been a construction worker, plumber, truckdriver, and electrician. Electronics had always been a hobby, but Vandersteen formalized his understanding by working in electronics during his stint in the Air Force. Back in civilian life, Vandersteen entered into speaker manufacture, producing the "baffleless" range, at least regarding the midrange driver and tweeter, which bears his name. The speakers, particualrly the Model 2 and its variants, have become, in a decade, one of America's most respected brands, despite RV's low-profile marketing techniques. I met with Richard at the Las Vegas CES in January and asked him what had got him started in loudspeaker design.

Richard Vandersteen: I came up with this idea for a speaker without a baffle in 1972, and started building them for people in our local area. A high-end store opened up nearby in Visalia, California, and they said "Let's take these things to Chicago." It was 1977. I said "Where?" because I didn't know of the Consumer Electronics Show. I took vacation time from my job, met something like 30 dealers and got 200 orders for about 250 pairs. I went back, told the boss I gotta quit, gotta find a building, because we were doing it in the garage and it was too small for that. That's how it started.

Ken Kessler: What inspired you to throw away the baffle for the mid and treble drive-units?

Vandersteen: In some of the experiments in the early designs, we were flush-mounting drivers, and I was sealing them in with silicone. My wife has a favorite record which has a saxophone on it—it was stolen, I don't remember what it was—but it was one of her favorite records and I used it a lot for testing. I'd blown a midrange and had no more new drivers, so to make sure it was still working without all of the problem of removing the silicone, which was very difficult to get out, I just laid the midrange up on top. My wife was around the corner in the kitchen; she said, "Richard, what did you do to the stereo? It sounds so much more real." I said, "Actually, it's not right." So I took the other midrange out and laid it up on top, and then went into the garage and got a stick and laid the tweeter on it, and that's where we came up with a tube. The problem was this thing was real ugly; she said, "There's no way you're going to leave those in the living room."

About three weeks later, as I was hanging up my jacket, I said, "closet pole." Then my wife sewed up some double-knit fabric which was in at that time—it's not any more—and made a sock to go around the loudspeaker because, she said, "you could never sell them that way."

Of course, three, four, five years later out comes the KEF 105 and the B&W 801 and they did very well with that modular affair. But that was the beginning of the Vandersteen range. It's the same design today; I just keep refining it with better drivers. The company finally got large enough that we could get custom drivers made, and that helped a lot. We wind our own capacitors, and on and on.

Kessler: The striking thing is, of course, the lack of a baffle. But that flies in the face of tradition. As everyone knows, the baffle isn't just there as something to hold the driver. The baffle affects dispersion, it reinforces the sound. How do you account for something that went completely against traditional lore for box-type loudspeakers?

Vandersteen: Partly by experiments. If you take a perfect tweeter and mount it in a baffle, of course you can put it in the baffle asymmetrically, round the corners and minimize the effect of the baffle, but the baffle is still there. However, you do have a problem when you have no baffles in that there is no averaging; with a baffle, when you strike your first boundary at a quarter-wavelength, you get a 3dB increase. And this is nice; by positioning the drivers you can be quite a bit cruder on the crossover and still get flat power response. So we did have to get involved in extensive use of compensating networks

and phase networks and so forth to make the drivers work without the assistance of a baffle, without any averaging going on, to make the speaker flat.

The crossover technology was the most difficult part of the design. Exactly as you said, you don't have this averaging effect that comes from the baffle. In hindsight, this is why the smaller speakers that were and still are popular in England always seem to be more natural when you have them out in the room: they in themselves have a lot of their frequencies unbaffled and . . .

Kessler: . . . behave like point sources?

Vandersteen: Yeah, exactly. The closer you can space that driver group, the better, the more realistic the speaker will sound in a room. And that's for two reasons: If you have a large source, even if it works as a true piston—let's assume 6' tall and 1' wide—you can, by designing it properly, make the sound hit the ear of the listener perfectly in phase. But you'd have a problem. The way the ear/brain works, as long as it has clues as to its environment, it's very good at separating your living room from the Steinway in that room. It should do the same with hi-fi. If your source is too large, you can design that source, with dynamic drivers or planar drivers or whatever, to hit the listener properly, but what gets all balled up are the phase differences and the time delay in all the room reflections. Even if you damp the room, no material is 100% effective in damping, and no material I've found is totally linear in its absorption characteristics. You end up with false clues.

For instance, if you put a squarewave into a Quad '63 (which behaves in a manner akin to a point source), you can get somewhat of a squarewave out of that speaker at the listening position. You could turn the microphone to the rear wall, side walls, up to the ceiling, anywhere, and all of the reflections within that room will be pretty close in shape to the original pulse that came directly from the speaker. You cannot do that with a multi-unit dynamic loudspeaker. You may have the individual drivers focused with delay and everything precisely on the listener so that you can make the squarewave hit the listener, but when you start looking at the reflections in the room, it's hopelessly messed up. There will be no recognition of the original pulse at all.

So I looked at perfecting that idea too, making sure that group was close, and that it loaded the room in a realistic way, so that all of that reflective energy would come to the listener in phase, or in sync.

Kessler: But you mentioned earlier that the biggest problem with baffleless driver mounting was compensating for phase and so on via the crossover. In taking care of the benefits of having a baffle which you sacrifice by not having a baffle, didn't you just trade one set of problems for another? In other words, you sacrificed a mechanical cure and replaced it with an electronic cure. Aren't they equally complex, equally flawed?

Vandersteen: They are equally complex, but the electrical cure is much easier to control. You aren't really trading one problem for another because when you get that first near-field reflection, the ear/brain combination has a very difficult time separating the source from the garbage. It's such a small period of time, and the ear is not so much an amplitude device as it is a time device. I think this goes back to prehistoric times, when you had to know where the bear was coming from. For instance, if you phoned me from England, I would recognize you, even though the telephone is a horrendous amplitude device. The ear uses time signatures and phase and so on; that's how we recognize what's realistic and what isn't.

Of course, we haven't accomplished perfection. Eliminating the baffle eliminates all of these earlier errors, because sound radiates from a transducer like ripples from a pebble dropped in a pond. When those rings first strike the baffle board, even if the board is padded with something or the corners are rounded (that helps minimize the problems of the baffle because it splays and averages the diffraction and keeps it from focusing on the listener), it is still a problem because there is a lot of time distortion in that diffraction. I have test equipment that can measure that very easily. You put in a source, hit it again with the same source, then vector the two together to get the difference of what came from the drivers and what

came from the baffle. What comes from the baffle is not linear at all. It's a mess.

Kessler: Yes, but you do compensate for that. You know what its characteristics are when you design a speaker with a baffle.

Vandersteen: You can accomplish flat amplitude response; it's easy to do that. But you can never correct for a time distortion.

Kessler: But there are other time distortions created by not having the rigidity of a tweeter and a midrange driver mounted on a baffle, which has to be greater than free-standing supports.

Vandersteen: We have a free-standing support, obviously, which is actually a small box. It doesn't matter, it could be a column, but the boxes are small enough, in order to make them very strong. Because of their columnar effect, you don't have to worry about the resonances in these materials because all these parts are different sizes. I use different thicknesses of wood, different damping material on the inside, so that if you assume everything has a problem, at least they never add on top of another. It's kind of like the random theory. But as long as those structures are less than a quarter-wavelength of the driver frequencies, you can say it's baffleless even though theoretically there's a very small box there. The old LS3/5A, for example, with the exception of frequencies over 5k and the sharp edges around there, was basically a baffleless speaker in my opinion. So is any other mini-monitor, at whatever frequency of which the dimension of the baffle is less than a quarter wavelength. Which goes quite high up in the midrange on a mini-speaker. And that, I think, is why, even though they have a lot of other problems—a small speaker's distortion is very high—they're still pleasant from a musical standpoint because they have minimized the time distortions created by baffle reflections.

Kessler: What are the aspects of a baffleless design that prevent it from attaining the levels of openness and absolute transparency of, say, a dipole, or a panel-type loudspeaker?

Vandersteen: That's a very good question. Panel speakers have a high end that is exaggerated in a way that's kind of opposite to a lot of recordings, but in the midrange—this is just my opinion—in the midrange, they have a genuine realness. Every one of them. Even the bad designs have a genuine something about them that just sounds so damn real. This has puzzled me for 17 years, but I think I've discovered what it is—they have no diffraction problems behind them until they hit the rear wall. So you don't get those minor time distortions you get from a baffle, when its energy is reflected and delayed and sent back to the listener no longer in phase or correct in amplitude, because you have to have a problem in the driver offset by a problem in the crossover and/or the baffle. You get too many wrongs trying to make a right, and I basically don't believe in that.

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It turns out that the internal diffraction problems of dynamic drivers are far greater or as great a problem as the problems with the baffle, because there's as much energy coming off the rear of the cone as the front of the cone, and here you have a big magnet and a basket and everything, with all of this crap delayed only two inches—in time a few milliseconds—before the sound is reflected back. We probably pioneered minimizing the external diffraction problems involving time and phase—people have said that they enjoy what it does for us, and I think it's real—so the natural extension was to work on our own drivers where we have no reflective surfaces behind the radiating diaphragm. We're applying for a couple of patents on it; we're using very, very powerful magnets I bought in England. They're very expensive, but that's the secret, because the structure can be very, very small. And the basket is configured in such a way that it has no reflective surface; it's like a spider's web.

Now, this vectoring thing I told you about where you can look at what's coming from the cone: you can vector it out and look at what's coming from elsewhere. I measure it with the microphone in front

of the cone, using the Crown TEF machine. You can eliminate the sound that came immediately from the diaphragm, take it out of the picture, and look at what's left a very small period of time later. It turns out it's only about 20dB down and is not linear: it's a lot of garbage.

Drivers have always been designed to be flat to take into account the negative effects that come back from all this structure, so without them, the cone itself has to be flat, without these reinforcements and cancellations and so forth going on at certain frequencies. It's been a very difficult four-year project, we've got an incredible amount of money involved in it, but it's finished now; the Vandersteen 3A's here, and that midrange driver is in it.

Kessler: Would you classify this as the first dynamic driver with all the beneficial properties of a planar driver?

Vandersteen: We don't know. The market will tell. I think this midrange approaches some of what drove me crazy for so many years about the planar speakers. We have more of that now. Do we have as much in all areas? Probably not. But then the planar speakers have other problems, so you're talking about tradeoffs here. Maybe we've made it close enough in that area so that some of the other advantages of a small point source are going to sway some people.

It's not a problem—we sell a lot of speakers—but when I listen, I always miss that midrange; midrange I could hear in a planar design so dreadful no one would give it a second listen. But if I listened around all that, it still had that midrange character I wanted.

Kessler: Because this midrange unit is a relatively new type of driver, doesn't it have its own signature that causes discontinuities?

Vandersteen: Our tweeters have already had that effect incorporated in them for the last three years. With a woofer, although it won't work in a two-way, in a three-way you can crossover out of them low enough to where these negative effects from the physical structures are happening at a higher frequency than you're using the driver to cover. A woofer's structure is basically transparent as long as you get out of it soon enough. Now at some point you get into the same problem as in the midrange frequencies, at 3–4kHz; a well-made, cast-aluminum basket, 8" woofer, any one of many good ones available, will have the same problem. But that's the whole beauty of a four-way or a three-way design—you can get out of it before that frequency.

We have had to redesign the woofer, but that was done because we were using the same basic woofer in our 1B, which is a little two-way. The reflection of the backwave is a great problem in a two-way. That was dealt with acoustically, not as well as in the midrange driver, but enough to keep it from nagging us on a three-way design. And it helped the two-way, but it just minimized the problem rather than solving it.

Kessler: What is the next stage in the refining of the baffleless system?

Vandersteen: The drivers have literally to be meshed to 0.1dB to make the concept work, because you don't have the averaging with the baffle anymore. So the crossovers and the drivers have to be fanatically matched to one another, and that is a production problem. It's also a design problem in that I have to find a faster way to do it. I'm very involved in computers right now. We've always done this, but I would like to match the drivers even more accurately to one another without having to jack the price up. That's something the Dutch in me won't allow to happen.

Kessler: You're now at a stage where you have models covering just about every level—though none of your speakers are actually budget designs—all the way up to the high end. Now, aside from production problems, which are refinements and have nothing to do with design, I believe that the next step in the development of the Vandersteen family has been working with subwoofers.

Vandersteen: Powered subwoofers. The only way to do it.

Kessler: Don't you find it a hindrance in the sense that you're supplying the amplifier, and that it forces the end-user to match whatever amplifier they want to buy with the characteristics of the amplifier you're using?

Vandersteen: We've got a unique solution for that. Our subwoofer is bizarre in that it has a first-order passive filter, nothing but a capacitor between the amp and preamp, rolling off the main amplifier and the main speakers at 6dB per octave, below 60, 80, or 100Hz—your choice. When I was developing the subwoofer, I found that the thing had to be quick, and it had to be floor-mounted so that you always knew its acoustic environment—the one thing we all have is floors in our homes. This thing is slot-loaded and floor-mounted. That makes things very predictable in low frequencies. That's one advantage. It causes some problems, but we can use a feedforward concept to solve those. The other thing I discovered was that many times the reason a subwoofer wasn't seamless was because you had different amplifiers, or different amplifier characteristics. And that was a big problem. So that delayed the subwoofer for three years.

We took an input circuit from an oscilloscope, which is a dual-differential floating input, so it doesn't matter if an amp's bridged: ground is not really ground. Our subwoofer samples at the amplifier output terminals. So you bi-wire, or if you're already bi-wiring your speakers, you tri-wire off the output terminals. The input impedance of the subwoofer/amplifier is about 4 Megohms. So the amplifier hasn't the foggiest notion the subwoofer is even there. It's like putting an oscilloscope across the terminals to see what's happening. It then samples that. Now remember, the amplifier is being rolled off below 80Hz by the passive filter, but those frequencies aren't gone, they're just attenuated as they go down. The subwoofer input circuit knows that this signal's been attenuated and restores it, meaning that you pay a 6dB penalty in noise. This is not a problem in the deep bass, at least not with the circuitry we're using.

This technique means that the amplifier playing your woofers sounds like you've got a great big version of whatever amplifier you had in your main system. The first negative comment we get is, "Wait, I've got a tube amp and it's not so great in the bass. You know, I don't really want that character carried on into the bottom." But a tube amplifier into a four Megohm load has a damping factor of how many thousand? It's only when tube amps have to deal with the mass and the movement of woofers that they take on that character. Their signal is state-of-the-art until it has problems dealing or interfacing with a large woofer.

In this case it has a four Megohm resistor to deal with, so it's no problem. Then you go through a high-current situation and there're three floor-mounted 8" drivers in there, a 300W amp, and it goes for it. So it will take on the little phase nuances and so forth that one amp has from the other. We don't know how to measure all these things, but we all know they sound different. But this thing will take on whatever character of amp you put on the top, minus some of the negative things. Those characteristics of an amplifier that are caused by a design problem are not passed on into the bass because that design problem has been removed. It's very innovative; I think it will be very widely copied in the future.

Kessler: Have you patented it?

Vandersteen: It is a patentable concept, but I basically don't believe in patents because, you know, who has the time to spend enough money and the time in court to back it up? In this industry there's not that much copying going on because the designers have a fair amount of ego, and no one will ever do it as cheaply as we can. I think it will be pretty obvious in the future who came up with the idea; I'll just let the market take care of it. Patents really don't protect anything. The US government will issue me a patent, but they're not responsible for enforcing it. That's done in the courts.

Kessler: Where it would cost a lot of money.

Vandersteen: Well, it's not the money, it's the time and the hassle. I've got better things to do. We're getting a patent on the concept behind this new

midrange, however, because I think that is special, and easier to enforce.

Kessler: What is the next stage of development?

Vandersteen: At this point, we're selling a lot of product in Europe, and I want to come up with a ".5," a very high-quality mini-monitor of some sort. That's the present project. In addition, for the last three years I've been doing a lot of work in surface-mount speakers, trying to make them work in a wall—I'm very frustrated by that. The environment just doesn't make it! I could make one a little better than somebody else's maybe, but I'm still investigating a way to make it really work. I guess it's because they just don't make recordings with the mikes against the wall. The bass has some great advantages, but in the mids and highs you get so many time distortions that you just can't make it sound real. You can make it sound good and pleasant enough that many people would buy them, but I'm not really interested in how many we can sell. Obviously I want to stay in business and make a profit, but I want them to be something unique and special.

Kessler: Wall-mounting a speaker would seem automatically to defeat the notion of the baffleless design.

Vandersteen: Exactly! Absorption is an option, but I haven't found a material yet that absorbs well enough and is linear enough.

Kessler: But the non-linearity is something you can compensate for in a known design.

Vandersteen: Somewhat, but that's almost like saying you can use feedback, and we don't like to use feedback; look at our subwoofer. There are many feedback servo-type subwoofer systems that go lower than hell, that will buckle the walls, that have low distortion numbers, but they sound like damn computers to me—they don't sound like music. I think the reason for it is that you can't let a woofer screw up and then say "Oh no! We screwed up! Measure how much!", and then bring it back around and correct for it. It's a fatally flawed concept.

Kessler: The servo subwoofers that I've heard have sounded overdamped.

Vandersteen: Yeah, but overdamping is easy to correct—you raise the Q, don't damp it quite as well. However, then you have another problem: it always seems to have something not quite right. You can't let something screw up and then decide to fix it later with feedback, because it's after the fact—again, a time distortion. We don't know how to measure that, don't know at what point it's too much, or less, or not enough. One advantage tube amps have traditionally had is that designers use less feedback in them.

Kessler: Tube amps do have lower damping factors.

Vandersteen: So what? You deal with those problems in other ways. If a guy makes a nice impedance curve on his speaker and put a little bit of output impedance in his formula when he designed the box in the first place, then a low damping factor works fine. It's only the guy who designs a speaker assuming zero output impedance who's going to have a problem. I don't think that's wise anyway—all amplifiers have output impedance. Even if they didn't, you still have speaker wire you have to connect it with, so our speaker works unusually well with tube amps with solid-conductor cable—I'm not saying I agree with that technology, but it works well—because we put some output impedance in the formula. We didn't assume an amplifier with an infinite amount of damping factor and zero-output impedance. Again, that's a problem, but you can control all those things, especially in a subwoofer with an amp. But there're so many advantages in low bass, knowing what woofer's going to be there, what box, how it's going to be configured, plus this other little trick we're playing, that it's a real advantage.

It's real important for systems to be musical. We can't turn ourselves into pieces of test equipment and try to measure how these things perform. You have to react emotionally. Music was Valium in the old days. If it's done properly and if the system's working properly, that is its function. It has been for centuries. We should address these things from a musical standpoint. Even though I'm very technological in my measurements, the ears are the bottom line, the final piece of test equipment. All you do is hope enough people agree with you that they keep you in business.