

# Stan's Safari 45

STAN DISCUSSES THE ADVANTAGES OF A LOUDSPEAKER WITH A SINGLE FULL RANGE DRIVER

It will be a mystery to many readers why some listeners still enjoy listening to their music through single drive unit loudspeakers when plenty of far more sophisticated multiunit alternatives are available. For me at least, all my early experiences of sound began with single drivers.

As a lad all the sound I knew came from single units in radios; televisions and record players, while the finest of sound systems (the Wurlitzer juke box) typically had a single 12 inch driver or, in the most acoustically advanced designs, two 12 inch units: one for the bass and as second one fitted with a small whizzer cone round the central dust cap, used for the midrange. And this gave the best of sounds; that rich, fulsome 'juke box bass', alongside a remarkable absence of high frequency noise from the records.

High frequency units (later known as tweeters) were very thin on the ground. The aforementioned whizzer cones became very popular because they gave a clearly audible and surprisingly natural boost to the largely missing higher frequencies.

In concept, the whizzer is a small cone about twice the diameter of the voice-coil at its outside edge, glued onto the end of the coil where it meets the dust cap. It is unsupported around its outer edge and therefore is made of a stiff self-supporting material.

The design is a bit hit'n'miss and so experimentation gives the best results, and I've yet to meet a designer who has a convincing theoretical approach to whizzer design. I do believe it was Gilbert Briggs of Wharfedale who first brought the separate tweeter into the home. In 1945 he introduced a loudspeaker with a 12 inch bass unit and a smaller HF unit. His first HF units used 10 inch cone drivers before introducing 3in and 4in

units in the 1950s, and then some later dome tweeters.

The first crossover was built into a very big wooden box placed externally, and had some massively over-engineered coils and heavy oil-filled capacitors (presumably surplus Ministry of Defence stock left over from the war). This early innovation was cool in a number of ways. It was probably the first multi-unit hi-fi loudspeaker; it kept the crossover external which is probably the best place for it; and it used cone type HF units which in the early days of stereo were superior to dome type units for corner positioned loudspeakers – which, of course, most were. But then Briggs was a man of remarkable innovation. Who else could step into a shop to collect his wife's dry cleaning and come out with the concept of foam suspension surrounds?

So what led Briggs to want to build a 2-way loudspeaker? Well he was a long-term observer of cinema sound systems. Originally such systems used a single horn but in the early 1930s research by MGM led to the Shearer 2-Way horn system which had a 500Hz passive crossover. This system was both efficient and had a response from 40Hz to 10kHz, but unfortunately reproduced lots of high frequency noise from the optical soundtrack. So was born the 'Academy Curve': a filter that rolled-off the response above 7kHz, getting rid of much noise but also a lot of signal. Nonetheless it remained in place in most cinemas until the 1980s and, oddly enough, I don't recall it being much of an impediment to my enjoyment of many films.

Briggs had heard several good systems including the Western Electric sound system at the local Coventry Hall Picture House in Bradford, and as soon as he was free of the demands of wartime production, he set about building a miniature cinema speaker. Following on from Wharfedale's early designs it wasn't long before almost every hi-fi loudspeaker worthy of the name was multi-way, and for a time more units meant better performance (and a higher price). Today, some loudspeakers claim to be 5-way – sub-bass; bass; mid-range; tweeter and super-tweeter!

The crossovers linking together these drive units were initially quite simple. By the 1990s some engineers had developed a good understanding of the way the networks integrated with the output of the drive units; aided by cheap computing power, we entered an age of complex networks that gave us ruler-flat frequency response. Flat it might have been, but this also led to an era of many loudspeakers that measured impeccably but sounded lifeless and unnatural.

I don't know if the two events were connected but we also began to see renewed interest in the



concept of single drive units and several new designs appeared from Jordan-Watts, Bose, Sumo, Fostex and others. These coned units had a diameter of typically 100mm with a hard rigid 'phase plug' replacing the simple dust cap. Such units often have a frequency response to over 15kHz, although when measured it can look very ragged with peaks and dips galore. Yet subjectively high frequencies can be very convincing, and certainly not apparently lacking. (Yet another mystery to be added to the question of why we can clearly perceive high frequencies which an audiologist will tell us we can no longer hear.)

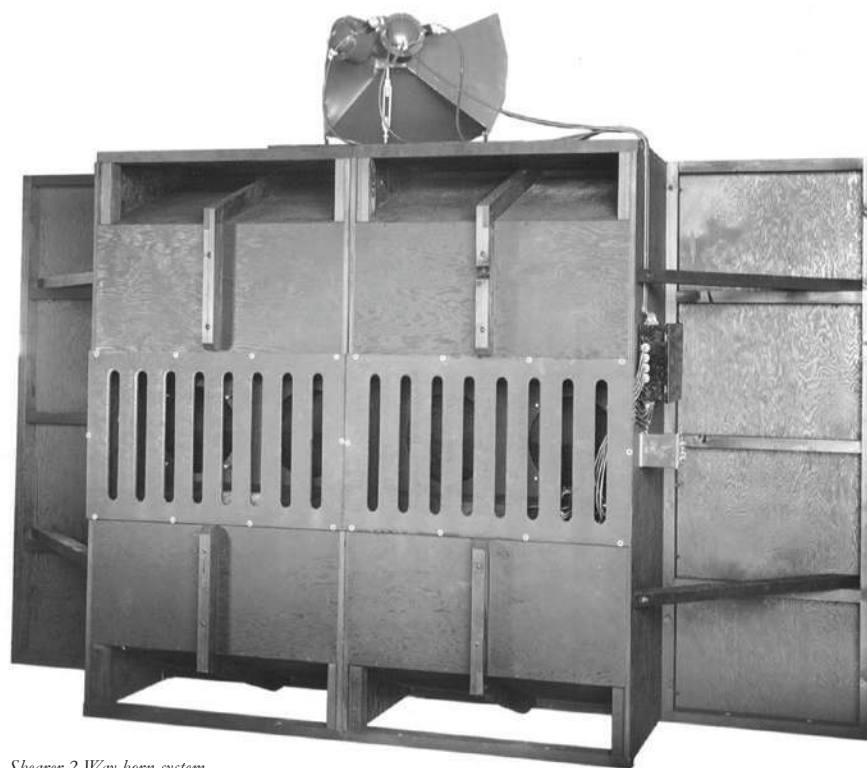
So what is it that keeps bringing some designers and many enthusiasts back to the single driver option? In the words of publisher Martin Colloms: "Direct amplifier connection, a coherent single source and very good resulting subjective dynamics contribute to an unexpectedly rewarding sound when judged on purely musical grounds".

Let us consider these points for a moment. I expect most people will feel intuitively that the amplifier should have a tight rigid control over the movement of the drive unit cone. This is described in amplifier terms as the Damping Factor, so an amplifier with an output resistance of 0.05ohms, driving a nominally 8 ohm loudspeaker will have a DF of 160, so will have a tight grip on the drive unit. But now if we wire a complex crossover network between the amplifier and the drive unit we may well introduce a resistance of 1ohm. The DF drops to 8 and cone control may get a bit sloppy.

The other selling point of a single drive unit is that it replicates real life. If someone talks to you the sounds they make all come from the mouth (ignoring room reflections and the ambience, for now). But when you play back a recording on a multi-way speaker you hear some of the sound from the woofer, some from the midrange driver, and some from the tweeter. All of these drive units are in a different location relative to your ear. So different frequencies will travel different distances to your ear and so arrive at different times. In other words the sound will no longer be time-coherent.

Now some of this can be corrected in the crossover design, but only for a single defined listening position. Move off-axis and the time differences reappear. This coherence might be important for creating solid stereo images but is not for everybody. Different listeners have different priorities. Some are sensitive to frequency response anomalies; others sense a loss of single source coherence; still others only want a really tight control of timing clues.

The negatives of the single drive unit solution are similarly dependent upon the listener when it



*Shearer 2-Way horn system*

comes to assessing their impact. Because the higher frequencies are being radiated from the centre of the cone and are often bounced off some sort of phase plug, the response may be irregular. There will be lots of high frequency energy but not necessarily in the form you'd like.

Another failing also is inherent in the use of a single cone. Play some heavy bass notes and the midrange will be modulated by the bass. This intermodulation distortion is easy to measure but there isn't much agreement on how disturbing low levels of IMD really are to the listening experience. Certainly some listeners simply don't hear anything to be critical about.

I have a pair of Eclipse single driver loudspeakers, and by any objective scale of measurement their performance is terrible (and is probably bettered by the early pair of Gilbert Briggs speakers sitting in my garage). The frequency response is jagged and the intermodulation distortion is alarmingly high. But hang them on the end of a good sound system and they are among my favourites. The sound is tight & crisp; the imaging is holographic and I just love the musicality of the sounds. I'm sure other single unit owners tell similar tales. So maybe there could be something wrong with the design of my speakers or maybe there could be something wrong with my hearing? I wonder if Gilbert Briggs got a similar response from his customers in 1945?

