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ENGINEERING STAFF REPORT

The New JBL Symmetrical Field Geometry and Flux Stabilized Magnet Structures

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JBL's NEW SYMMETRICAL FIELD GEOMETRY AND FLUX STABILIZED MAGNET STRUCTURES

For more than thirty years, JBL has used Alnico magnets in the design of compression drivers and larger cone transducers. In these applications, Alnico magnets have guaranteed the high flux levels and low distortion which have been always associated with JBL products.

Over the years, most of the loudspeaker industry converted to ferrite magnet structures for their larger devices. JBL resisted this change and preferred to stay with Alnico, with its inherently low distortion performance.

However, as part of JBL's ongoing research activities, ferrite magnets have been studied along with other types, and we are now in a fortunate position to offer an optimized ferrite structure which outperforms those in current use in the industry and which, in fact, *exceeds* the performance of our conventional Alnico structures.

The improvement has been in reducing second harmonic distortion through attention to both gap geometry and the characteristics of the magnetic circuit itself. The Symmetrical Field Geometry (SFG) in the gap area provides magnetic flux lines which are *equal* both above and below the top plate, and it is this symmetry which contributes to a reduction of second harmonic distortion.

Another source of second harmonic distortion in magnetic structures results from an interaction of the AC flux field generated by the signal in the voice coil and the constant flux field of the permanent magnet. On alternate cycles the two fields add, and on the other cycles they subtract, creating a non-linearity which also increases the level of second harmonic distortion. Ferrite structures are more susceptible to this effect than Alnico. The cure for this was found in the application, somewhat modified, of a technique JBL has used for years in compression drivers and the LE8T– the silvered pole piece. In the present application, an aluminum *flux stabilizing ring* is located on the pole piece. Acting as a shorted secondary turn of a transformer (with the voice coil acting as the primary), the ring sets up a *counter* flux which opposes the flux change caused by the interaction of the voice coil and the magnet structure. The effect of the stabilized flux in the gap is to further reduce second harmonic distortion.

Figure 1 shows the fundamental with second and third harmonic distortion components of our new 128H LF unit operating with our conventional Alnico magnet structure. For ease in reading, the distortion components have been shown *raised* in level 20 dB. Note that in the mid-band, distortion components are some 40 to 45 dB below the fundamental. This corresponds to harmonic distortion below 1%. An input power of 10 watts was used in making these measurements.

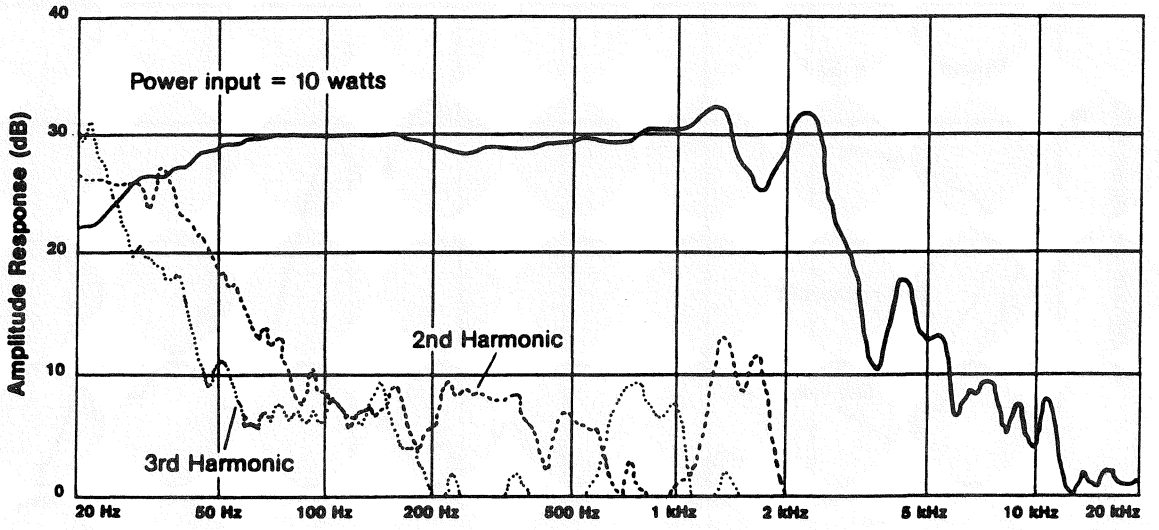

Figure 1

Now, if the moving system of the 128H is placed in a conventional ferrite structure of the same basic gap dimensions and flux density, we see in Figure 2 the increase in second harmonic distortion long asssociated with these structures. Here, the distortion is about 35dB below the fundamental, corresponding to distortion in the range of about 2%.

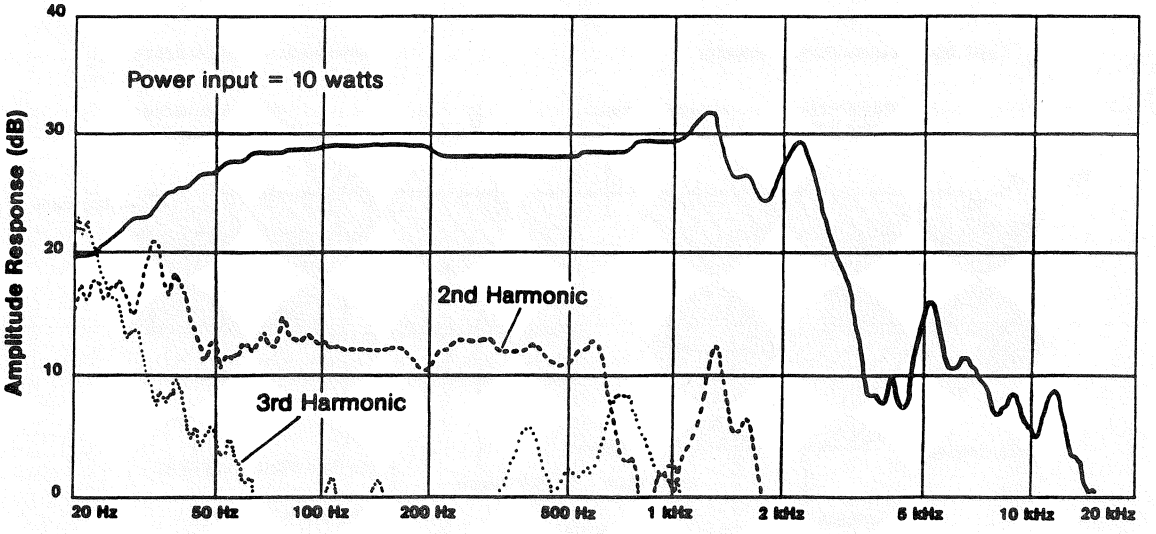

Figure 2

When the improvements of gap geometry and the flux stabilizing ring are added, we see the impressive results in Figure 3. Here, the 2nd harmonic distortion components have literally fallen off the chart and are at least 50 dB below the fundamental, an astounding 15 dB improvement over Figure 2. This corresponds to distortion in the 1/3% range. At a more normal 1-watt power input level, the distortion would be even lower.

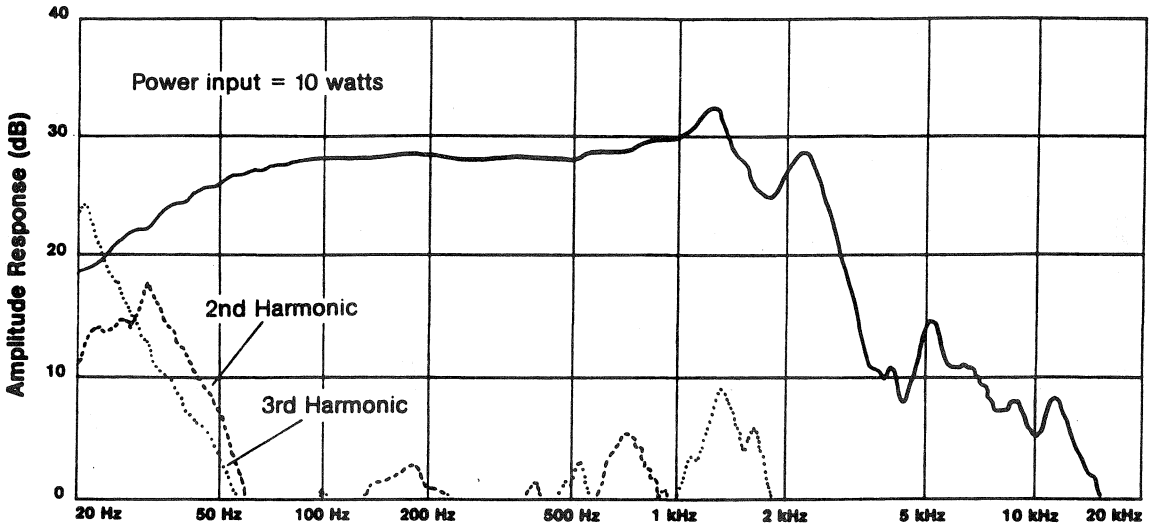

Figure 3

Note that third harmonic distortion remains fairly constant in these three figures; it is largely a function of the mechanics of the moving structure and the gap length–voice coil length relationships. These were the same for all three measurements.

Figure 4 shows a cutaway illustration of the new structure, comparing it with typical conventional ferrite structures.

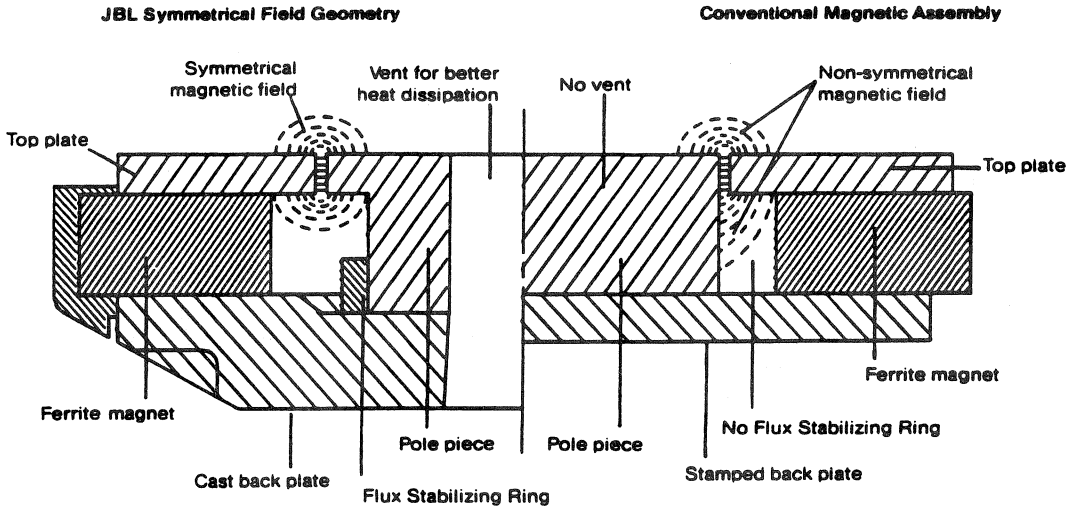

Figure 4

It is, of course, no happenstance that cobalt, an essential ingredient in Alnico, is in short supply. Most of it is being used in high-technology metallurgy, with little left over for magnets. Thus, our development is as timely from an overall production point of view as it is from a performance point of view, and we are delighted to offer this high level of performance to our customers.