where Z_S is the impedance of the driver. As stated earlier, current feedback increases the effective output impedance of the amplifer, A, and raises the system Q of the loudspeaker. Velocity feedback is then used to flatten the frequency response. Since the velocity signal rolls off at -20 dB/decade above resonance, only the frequency response around resonance is affected.

A subtle but very important benefit of the UCUV system should be pointed out. Since the velocity signal, which reshapes the frequency response around resonance, is derived from the actual cone acceleration, the system is self adjusting in terms of frequency response manipulation. Unlike systems such as those in (2), that depend on close matching between loudspeaker system parameters and active filter circuits to achieve a desired frequency response, the UCUV system is completely insensitive to loudspeaker parameter variations. Since driver parameter spreads can be as large as ±20% or more, insensitivity of the UCUV system to these parameter spreads is a major attribute. UCUV is essentially a universal motional feedback system applicable to any closed-box system using a cone driver. This feature plus the fact that complete system adjustment may be performed with only one potentiometer makes the UCUV feedback system a powerful tool in high quality loudspeakers design.

5. Conclusions

Theory was presented which indicates that improvement in both frequency response linearity and driver distortion can be achieved using UCUV feedback in a loudspeaker system. System Q is decoupled from enclosure and driver parameters, giving wider latitude of design of closed-box loudspeaker systems. Data from two loudspeaker systems using the UCUV system was presented, and confirmed that a substantial increase in system performance was possible using a very simple hardware implementation.

References

(1) Egbert De Boer, "Theory of Motional Feedback," IRE Transactions on Audio, January-February, 1961.

(2) Karl Eric Stahl, "Synthesis of Loudspeaker Parameters by Electrical Means: A New Method for Controlling Low Frequency Loudspeaker Behavior," Journal of the Audio Engineering Society, September, 1981.

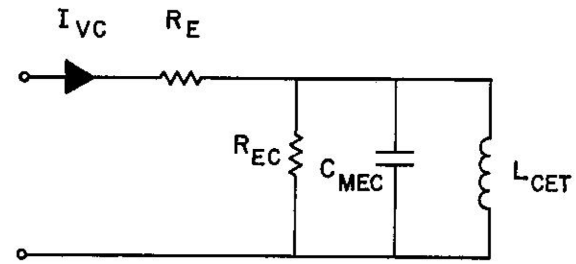

Figure 1. Electrical equivalent circuit of loudspeaker system.

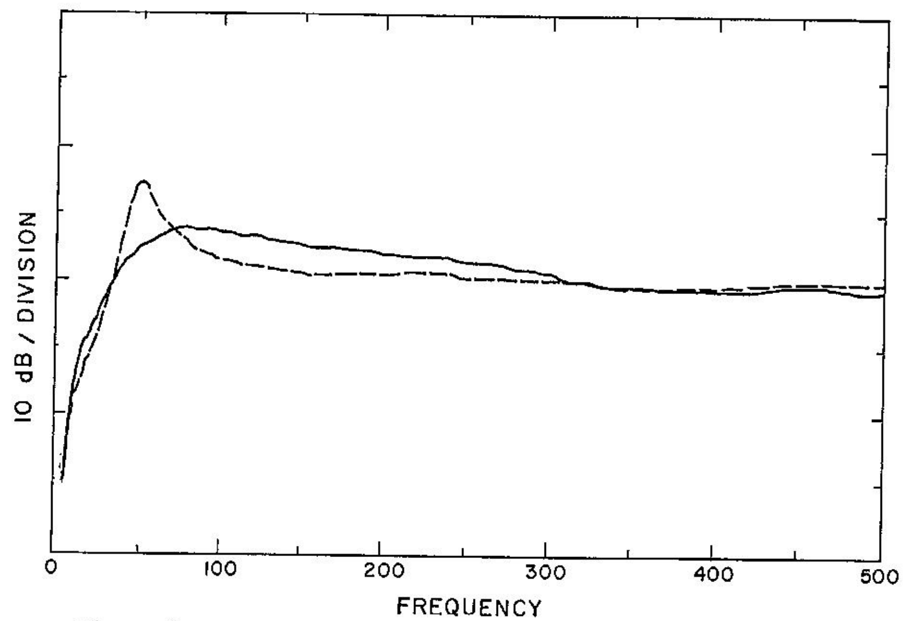

Figure 2. SPL response of a 12" driver in a 60 L enclosure. Solid line is SPL response without current feedback. Dotted line is SPL response with current feedback.