simple to build a gadget to indicate how your system is doing with music played through it. Meters just don't react fast enough unless supported by storage or logic circuitry, and I said "fairly simple." Light-emitting diodes (LED's) not only react fast but are inexpensive, and the circuitry needed to utilize them as clipping indicators is easy to build, as shown in Fig.1.

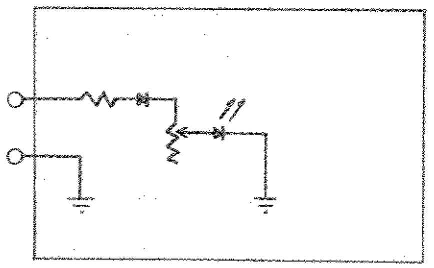


Fig. 1. The simplest and cheapest; it can easily be built into a speaker system. Try one unit located with the amplifier, switchable to either channel. As in all the examples, choose an input resistor based on the output of your amp. You might prefer a pot rather than a fixed input resistor, if you plan to use your unit on more than one system.

LED's are such low power consumers that the amplifier doesn't notice anything past the first (current limiting) resistor. Where shown, different color LED's can be used to denote different states of operation. As you can see, the unit can range from very basic (one LED) to relatively complex; it can become a very useful piece of audio gadgetry. Take your pick: here's how to use it.

First, use a signal generator (or test record with sine waveforms) and a scope to determine the system's treatment of the signal at high amplitude. The scope picture should be of the amplifier output, and a dummy load is recommended unless your system (and ears) can handle the noise. Increase output until the scope shows clipping, back off on the gain until the waveform just barely returns to its original shape, and adjust the potentiometer(s) to start the LED glowing.

As is, you'll have a valid indication of steady state clipping, though the line's a fine one and complex music signals aren't the same as a sine wave. That's it for a single LED unit. The more complex units shown in Figs. 2 and 3 permit adjustment of each LED, or meter, to mark an appropriate amplitude.

You might save one of them to show clipping on transients. To adjust the potentiometer controlling that one, use the scratched test record. Simply increase gain of the audio system (while reducing it on the scope, of course) until the waveform of the "pop" changes shape. Adjust the LED's input and *voilà!*

Selection of values for the components of circuits in Figs. 1 - 3 is noncritical--your parts box will probably hold a combination which will work. Use $E = \sqrt{PR}$ to determine the approximate voltage across the speaker at the rated output of your amplifier, if you're interested.

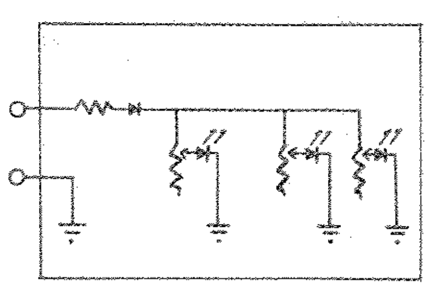
Use $R = \frac{\sqrt{PZ}}{I}$ to determine the approximate resistance to be placed in series with the LED. I = the current flow required for illumination of the LED. The fixed resistor should equal about 50% of the total required, and the potentiometer need only exceed the total to work. With a 50 watt amplifier there might be as much as one watt dissipated by the circuit; choose values accordingly.

It's also possible to package the simpler device and calibrate it to the advertised output of a friend's amplifier. It's not cricket to deliberately err in order to convince a fellow audiophile that he listens to 50% clipping.

This article shares with you what I've deduced, induced, and sometimes (luckily) been able to measure concerning the often ignored transient characteristics of audio equipment. If the other necessary performance features of a good audio system are coupled with a wide dynamic range, the result can be gratifying. It's disturbing to listen to what should be an excellent system and find it suffering from some sort of transient "bottleneck!"

If you use this article as a starting point, evolve your own approach to the problem, and solve it satisfactorily, you may find that the major limitation is the product of record/tape manufacturers. When that occurs, start writing nasty letters to those firms, and also to the editors of audio magazines who permit disc/tape sound to be graded "good," "very good," or "great!", depending upon how the reviewer liked the music played on his home entertainment center.

Fig. 2. More complex, but still cheap. Use different color LEDs to show various states of operation.



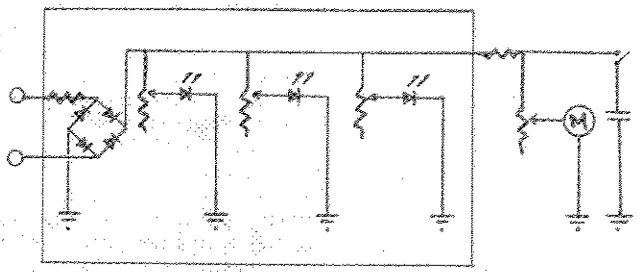
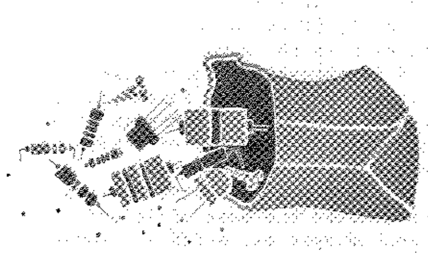


Fig. 3. Here's the most sophisticated tried by the author. The optional meter circuit permits monitoring of operations on a continuing basis. Adding the capacitor (100-200µFd) permits display of something close to rms.



MORITKO: AR TURNTABLE
Continued from page 11

special AR washer nut assemblies. (see Fig.8). Lower the arm through the hole in the turntable deck, and rest the arm mounting flange on the upper surface of the "T" subassembly (Fig.7). Adjust until you get the correct stylus to pivot distance and also the height of the arm until it is parallel to the surface of a record. Adjust the AR washer assembly so the arm and table are balanced without touching any inner surfaces.

Place the counterweight properly and align the arm according to the maker's instructions. I use the AR arm rest with the Lyre lift which I installed by drilling a single hole.

While this article describes a technique to put the Decca arm in the AR turntable, the subassembly can be altered to accommodate other installations.

An amateur's version of the Heil air motion transformer

by Neil Davis

THE HEIL DRIVER is a high frequency loudspeaker which is simply astonishing in its ability to reproduce music with very low distortion. It can be driven to extremely high volume levels, is very efficient, can be used safely with any type of amplifier, and can be built at home with common materials.

The theory of operation is embarrassingly simple. An electrically conductive path is implanted in a thin polyethylene diaphragm, which is folded to have pleats like a drapery. The diaphragm is immersed in a strong magnetic field, and the interaction of the current flowing through the conductive path with the magnetic field produces a force which is normal to both the direction of the current and the direction of the magnetic field.

Alternate pleats of the diaphragm, therefore, either move toward each other, forcing air out of the fold, or else (on the other half of the cycle) move away from each other, pulling air in. The beauty of this approach is that the air is moved directly by the "voice coil," so to speak. In a dynamic speaker, the voice coil windings are attached to a comparatively heavy speaker cone, and this extra mass impairs the loudspeaker's ability to move quickly, resulting in poor response at higher frequencies.

In the Heil, the total mass of the elements which move air is extremely low. Thus, transient response is excellent and high frequencies are clear and well-defined. And because all moving elements are directly controlled by the magnetic force and the device has no speaker cone to "break up," there is no doubling and harmonic distortion is very low.

The plastic in which the conductive material is embedded almost completely dampens the diaphragm of any internal resonances, so that the Heil driver does not sound like paper or metal or mylar--the sound is not colored by the driver materials. Also, the multiple pleats in the diaphragm move sound independently of each other, so that any individual peaks or dips in the frequency response will be averaged out by the others. So the frequency response is very smooth and is flat from 1kHz to 20kHz.

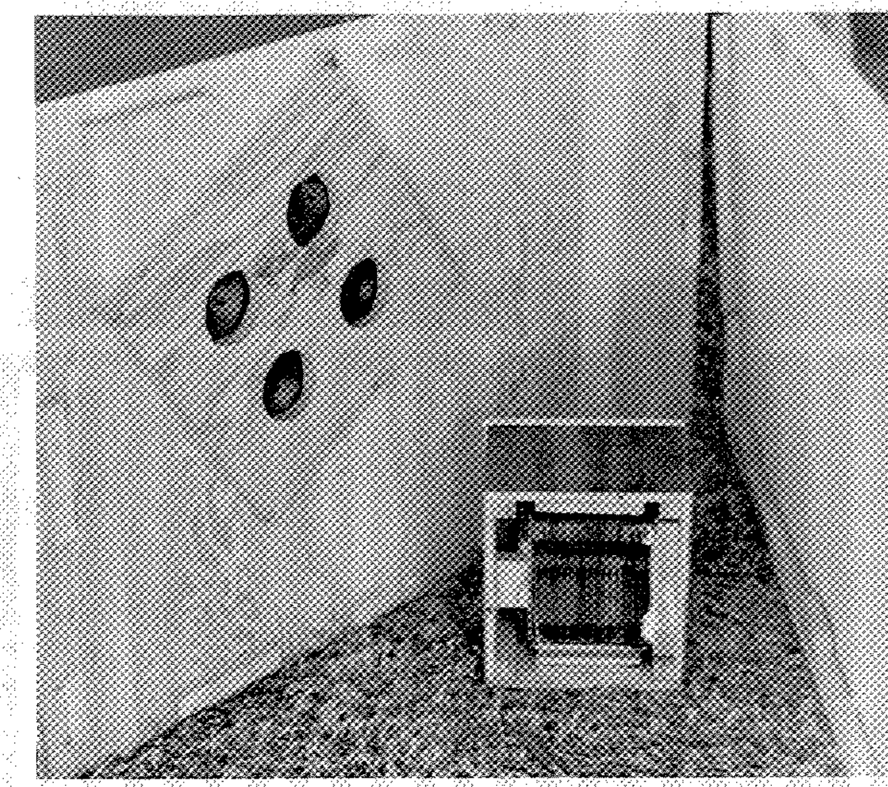


Fig.13: The author's Heil-type unit on its side on the floor in front of his horn (Issue #1, 1977).

ESS explain the operation of the Heil driver by comparing the action of the diaphragm to the air rushing from the door of a room as the walls move, supposedly squirting air through it at some tremendous velocity. I feel this explanation is easily discounted since the diaphragm pleats can be spaced apart somewhat--or, in their analogy, the door can be made much larger--and no degradation of the sound occurs.

The Heil driver is essentially a very clever refinement of the old ribbon speaker, and is essentially the same type of driver as the Magneplanar speaker or the new tweeter KLH is using, only the diaphragm is folded up and placed in a more powerful magnetic field. However confusing ESS's advertising copy may appear, they must ultimately be complimented on an excellent loudspeaker. The design opens the way to producing much better speakers than ever before.

The Heil driver described here is not quite as excellent as the one marketed by ESS. It cannot handle the full 300 Watts that theirs can, and it has a tendency to rattle at frequencies before 1000Hz. However, I believe it is safe to say that for frequencies above 1500Hz it is still superior to any dynamic speaker made, superior to any piezoelectric speaker, and probably superior to any electrostatic unit. I believe, further, that by crossing over a mid-range Heil driver to a tiny mini-Heil for high frequencies, even the sound of the ESS units can be surpassed.

I have come to believe in the relatively recent trend toward non-directional drivers as a means of achieving a more natural sound, uncolored by phase problems and heard from reflected sources instead of from directional sources. The high end of the ESS units is obviously clean, clear, and low distortion.

However, the units are very directional in the vertical plane, and when listening on a level with them the high end sounds overbearing, unnatural, or somehow wrong--completely different from other fine speakers with excellent high frequency response such as the Mac-