Intosh or the Dahlquist.

The high end can be made to sound more like the Dahlquist or, alternatively, more like the ESS units, by putting the same diaphragm in either a "bipolar radiator" type of magnet structure (ESS), or in a non-directional magnet structure. Through experimenting in this way, I have concluded that the issue of non-directionality and the problems of phase and refraction may help account for the oftentimes startling difference in sound between two quality speaker systems.

For the driver to be non-directional, it must be physically smaller than the length of the highest frequency sound wave it is reproducing. Since a 5kHz wave is about 2½ inches long, a 2½" x 2½" diaphragm should be crossed over at this point rather steeply to a diaphragm which is smaller than 3/4" x 3/4". It will still be somewhat directional at this frequency, but quite acceptable. The 3/4" x 3/4" driver begins to roll off at this frequency. Dimensions for both drivers are given in Fig.1.

However, directionality is an issue only to those seeking perfection. The directional form Heil is easiest to build, for several reasons. I suggest avoiding the hassles of crossovers and the nerve-wracking challenge of making the mini-Heil diaphragm, if your goal is simply to attain an ultra-low

FIG. 1

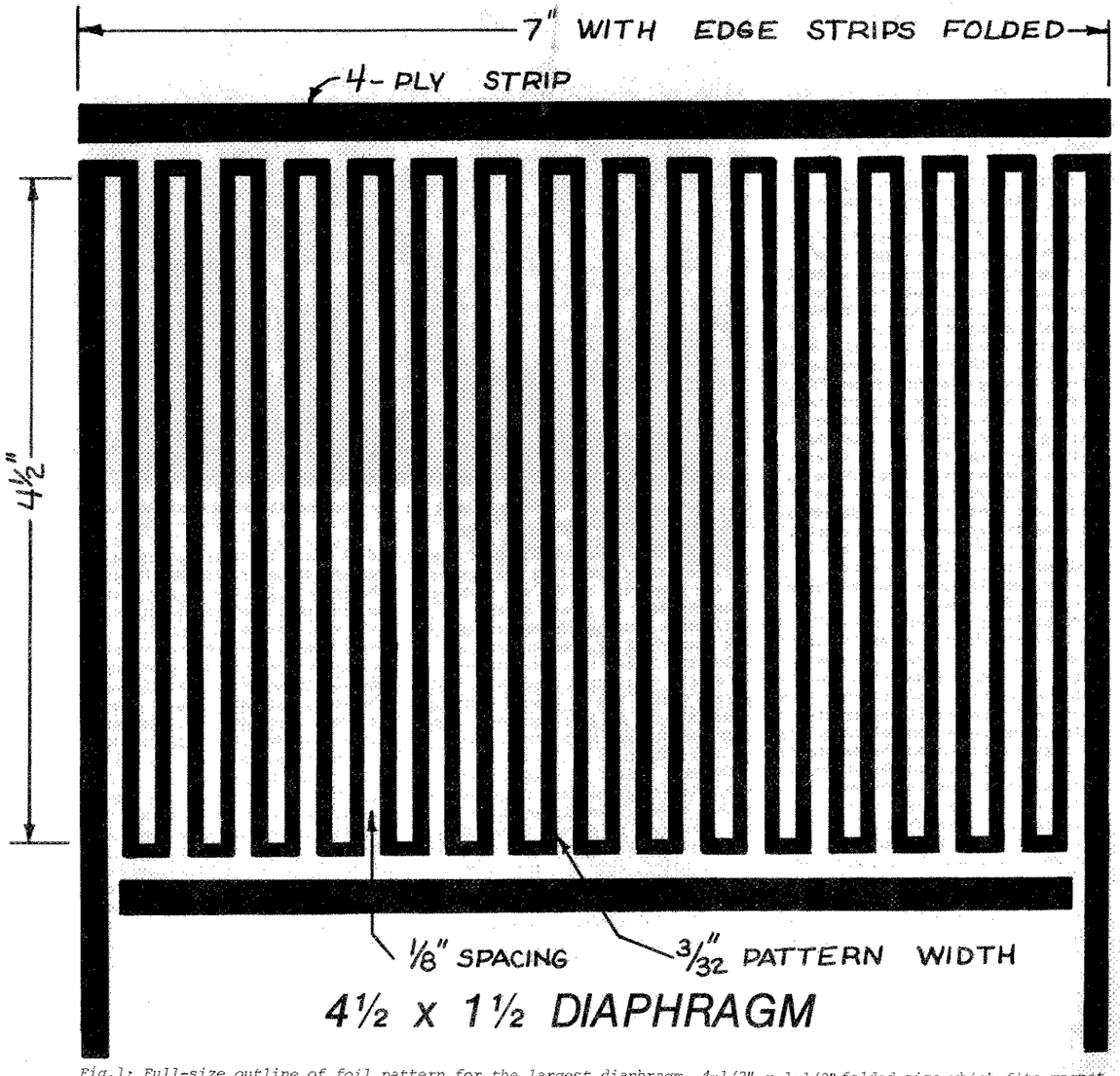

Fig.1: Full-size outline of foil pattern for the largest diaphragm, 4-1/2" x 1-1/2" folded size which fits magnet structures #1 and #2.

distortion, outstandingly clear tweeter/midrange. The best diaphragm to meet this goal would be the one dimensioned in Fig.2, and the easiest magnet structure is 3b.

Diaphragm Construction

The diaphragm for a home-built Heil does an excellent job, in spite of being somewhat crude. The conductive path used here is aluminum foil, which must be very carefully cut with razor blades and a straightedge. A diaphragm using heavy-duty foil has a DC resistance of 1.4 Ohms for a path length of 11 feet (which is the length of the 2¼" x 2½" diaphragms), whereas the standard foil has a DC resistance of 1.8 Ohms.

The impedance in a good magnet structure at 1kHz or above is always above 2.2 Ohms with heavy duty foil and 3 Ohms with standard foil. (Of course, the path length of the diaphragm can always be made longer to raise the impedance, or the foil can be cut narrower.) But since the Heil is usually used with a dropping resistor to limit output because of its high efficiency, the diaphragm using heavy duty foil will not present an excessive load to solid state amplifiers.

The heavy duty foil is much easier to work with than the standard foil and is best for experimenting

FIG. 2

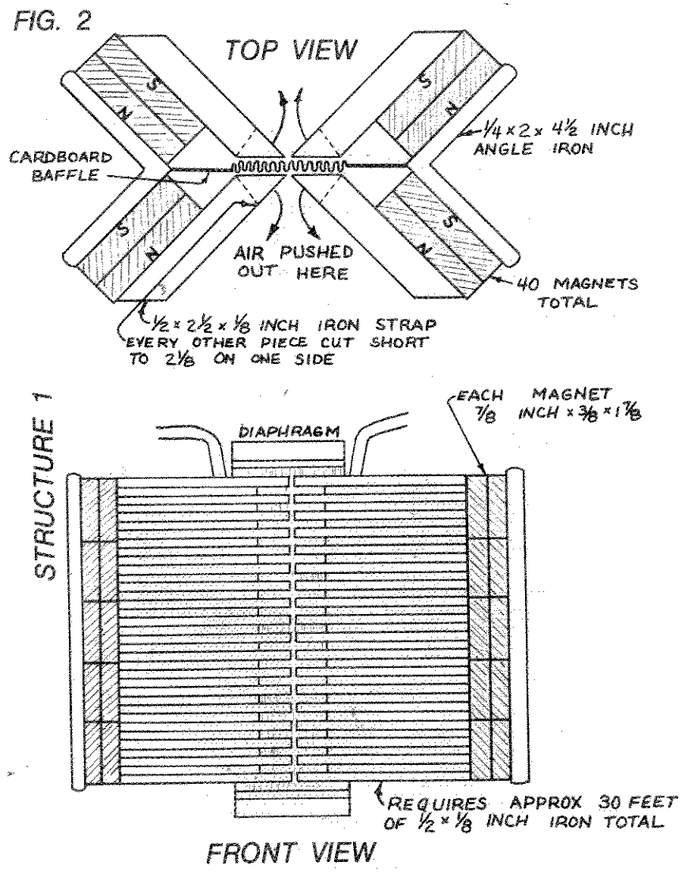

Fig.2: Magnet structure #1 uses the largest diaphragm and 40 magnets. The front to back gap between pole pieces is 1-4". Mount the sides so the points of the iron are as close as possible without touching.

or practice. The standard foil might be better for a final product as it is lighter and does not require as large a resistor to bring the impedance to a safer level. Standard weight foil should be used in the mini-Heil.

Cut out the foil pattern shown in Figs. 1 or 2 using sharp razor blades (plan on using at least eight blades per pattern) for the long cuts and scissors or blades to make the short cuts. Use a straightedge to keep the foil flat against some cardboard as you cut.

After the pattern is cut and the scraps removed, fold up the wide end strips several times to the width of the other vertical strips, so you have good strong strips to which you can connect the amplifier. Fold over some extra foil four times and cut a quarter-inch strip to put along the top and the bottom of the pattern (this will give the diaphragm some support so it will fold easily and stay folded).

Next, tape to your work surface a piece of light-weight plastic drop cloth (the cheap stuff, very thin polyethylene, usually sold as 3 yards x 4 yards for 25-50 cents). Brush completely with a light layer of rubber cement. Allow to dry without touching until the plastic completely returns to its original shape and all the cement looks dull.

Very carefully slide the foil pattern from a board propped over the sticky plastic and position each segment of the foil individually onto the cement. Use fingers, tweezers, and unending patience to get the foil onto the plastic--the foil is easily torn. (Whisky sours sometimes help.) Do not try to press the foil into the plastic too hard at this time, as the rubber cement is easily pulled up.

When the pattern is in place on the plastic, put the ¼" four-ply strips along top and bottom, as shown in Fig.2. Tape another piece of plastic to the table and cover with rubber cement. Allow to dry as before. Cut out the plastic with the foil pattern by going along the perimeter with a razor blade.

Carefully, using all three hands, turn this plastic and foil piece upside down and press it onto the second piece of plastic taped to the table. The foil will now be permanently sandwiched between two sheets of soft plastic. Run your fingers along the pattern to press the foil snugly to the cement inside the diaphragm, and to smooth out kinks in the foil and wrinkles in the plastic. Do not be too concerned if there are wrinkles, kinks, or air bubbles which will not smooth out.

The diaphragm can be very crude, sloppy, or blemished and still give wonderful results. The mini-Heil