The Sum of the Parts

The Whole is Equal to the Sum of the Parts

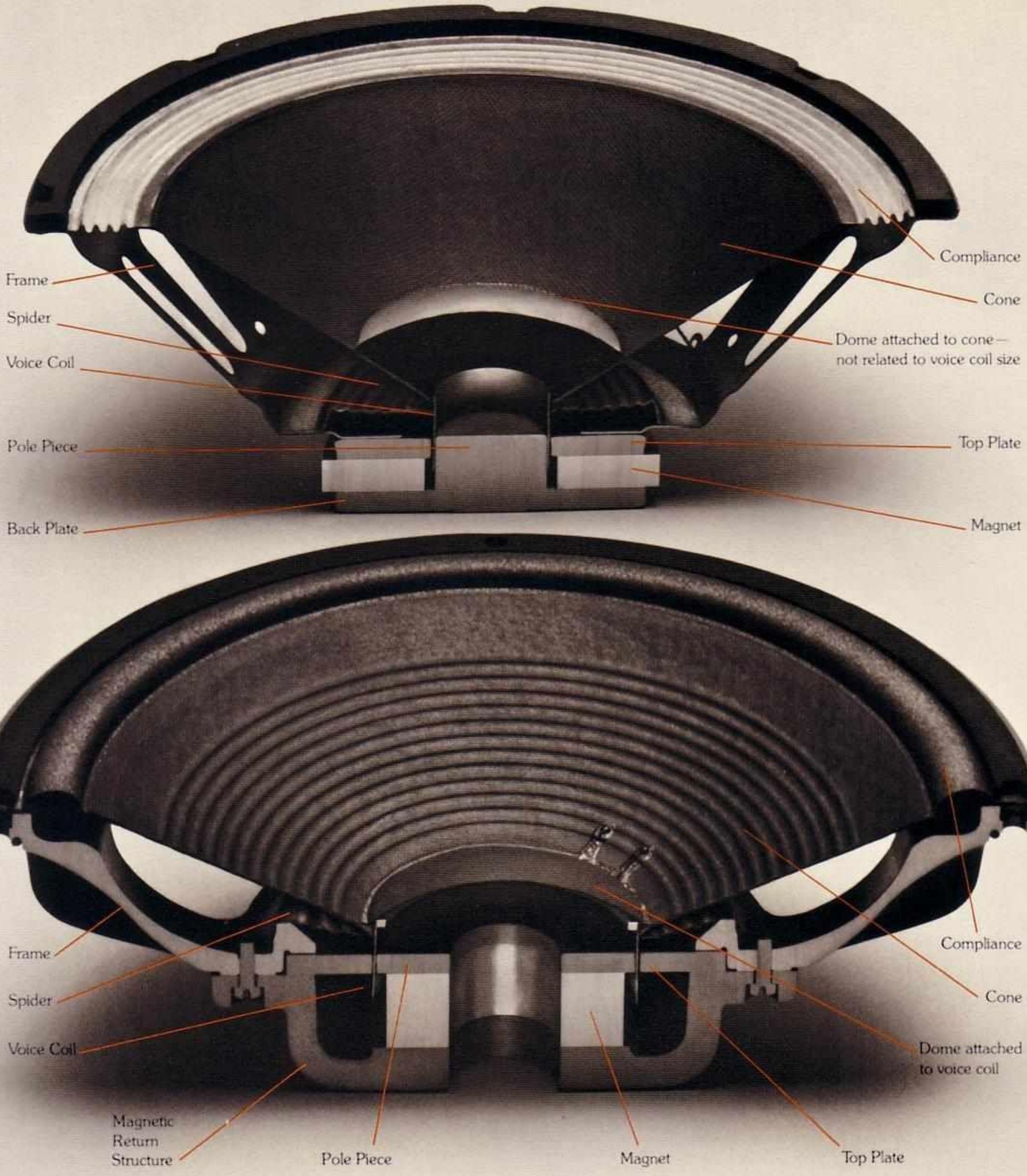
Consider the cutaway speakers at the right. They operate on the same principles by a basic design common to both. A design that hasn't radically changed in years.

An amplifier sends musical signals in the form of electrical energy to the voice coil which is suspended in a magnetic field within the voice coil gap. The electrical energy applied to the voice coil makes it a temporary magnet. The varying attraction of the voice coil to the permanent magnet causes the voice coil to move back and forth, and the attached cone to vibrate. The cone's vibration moves air which is perceived by the ear as sound.

The low frequency loudspeaker at the bottom of the photograph is a JBL 126A which is found in the Jubal L65. The one above is typical of the low frequency speakers used by most other loudspeaker system manufacturers. If they operate on the same principles, can one be greatly superior to the other? There's a visual difference, but does that necessarily mean an audible difference?

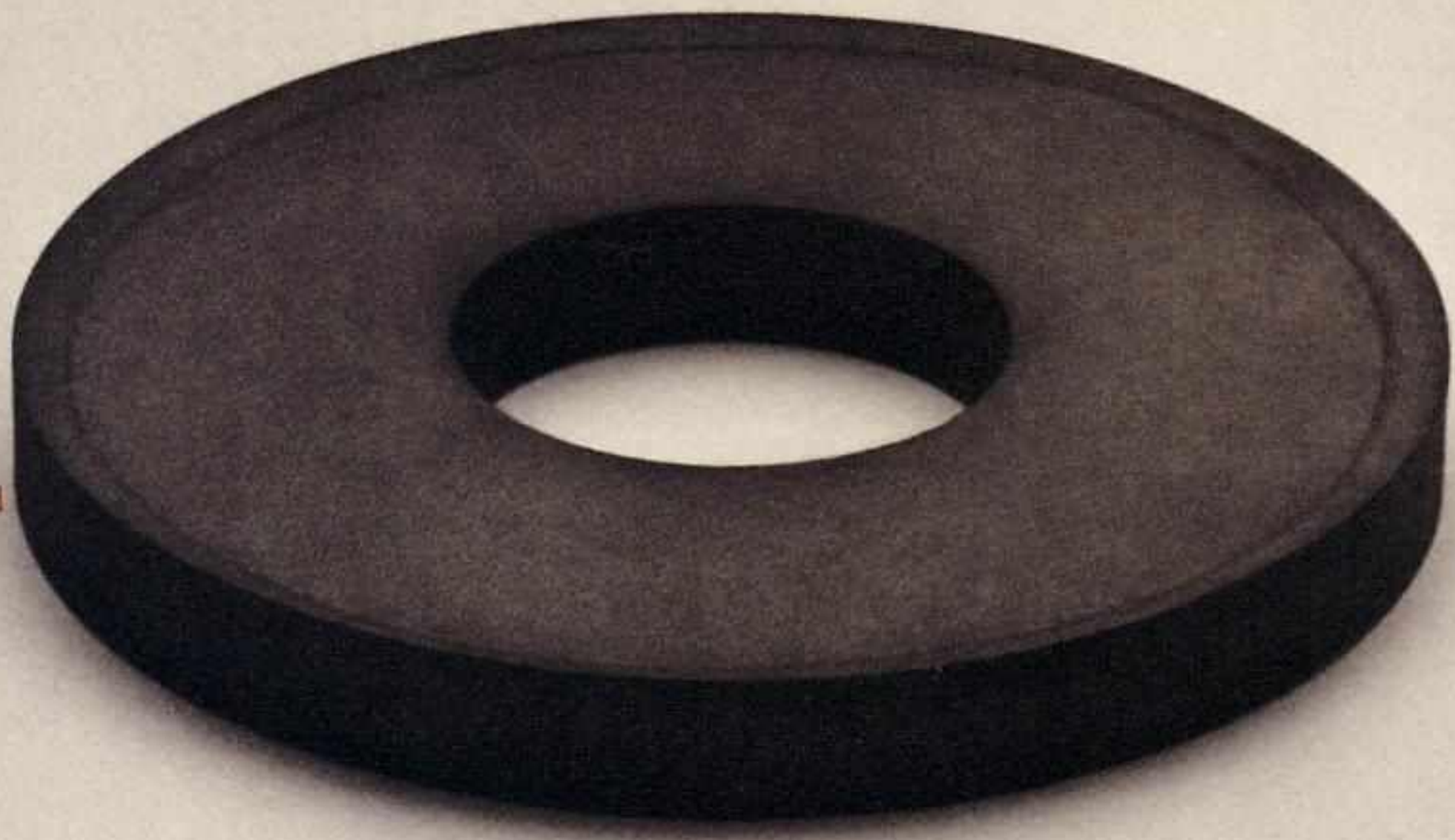
The answer to that is found by dismantling the two speakers. One shows many improvements on that common basic design. An examination of the parts discloses evidence of the superiority of one speaker.

Fig. 1

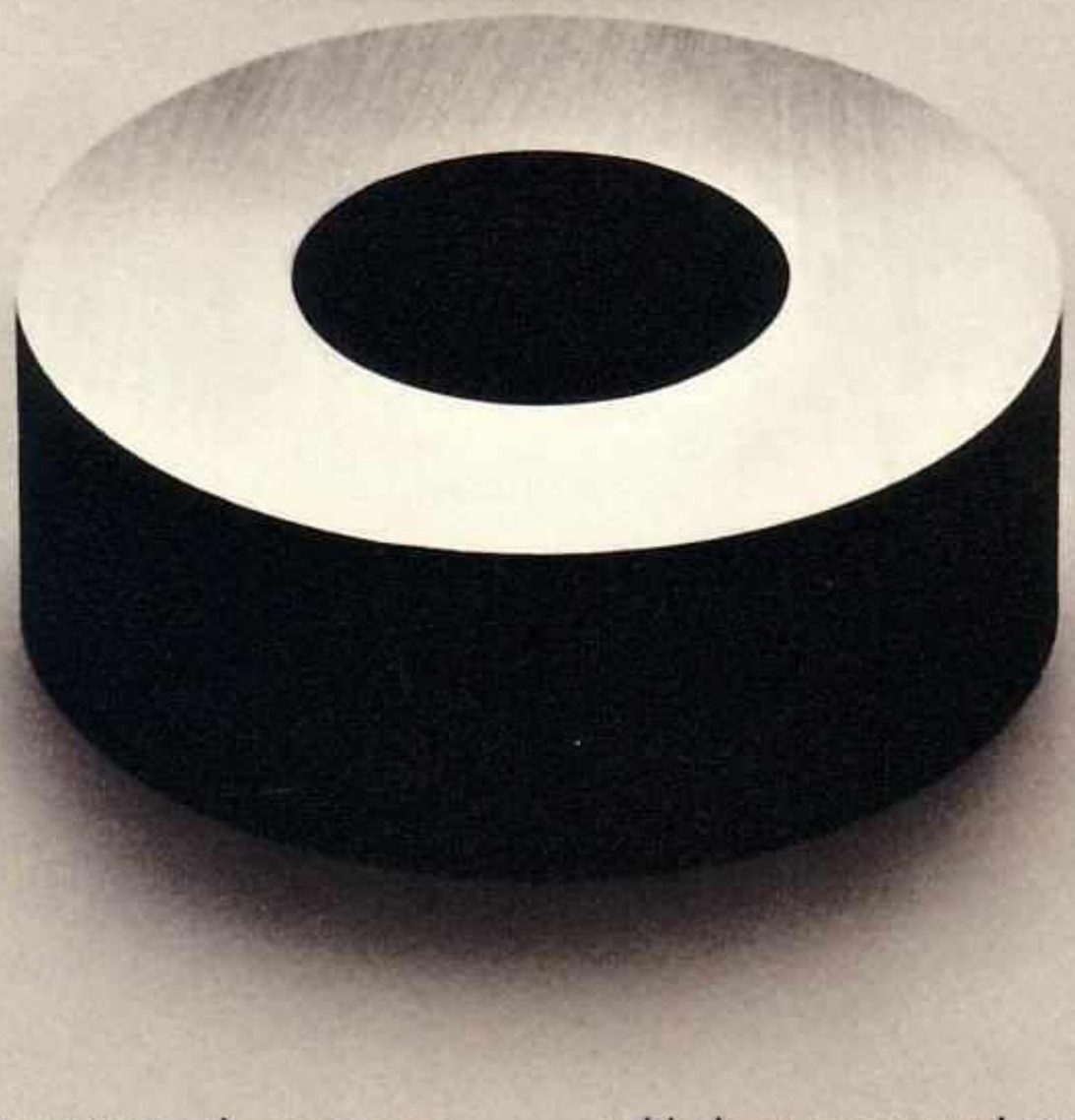

Frame
Spider
Voice Coil
Pole Piece
Back Plate
Compliance
Cone
Dome attached to cone—
not related to voice coil size
Top Plate
Magnet
Frame
Spider
Voice Coil
Magnetic
Return
Structure
Pole Piece
Magnet
Top Plate
Compliance
Cone
Dome attached
to voice coil

The Magnets

Fig. 2



The conventional speaker has a ceramic magnet. Ceramic magnets are made up of bits of alnico suspended in a ceramic material.



The JBL magnet is Alnico V. The Alnico V magnet is an alloy of aluminum, nickel, cobalt and iron.

Though different configurations, the two magnets weigh the same. But pound for pound the Alnico V has an energy product that is 2½ times greater than the ceramic magnet. Additionally, the ceramic magnet is not as suitable in this application because its very poor thermal conductivity limits its ability to dissipate the considerable heat generated in the voice coil gap. If the heat in the gap is not dissipated, power handling capability of the speaker diminishes.

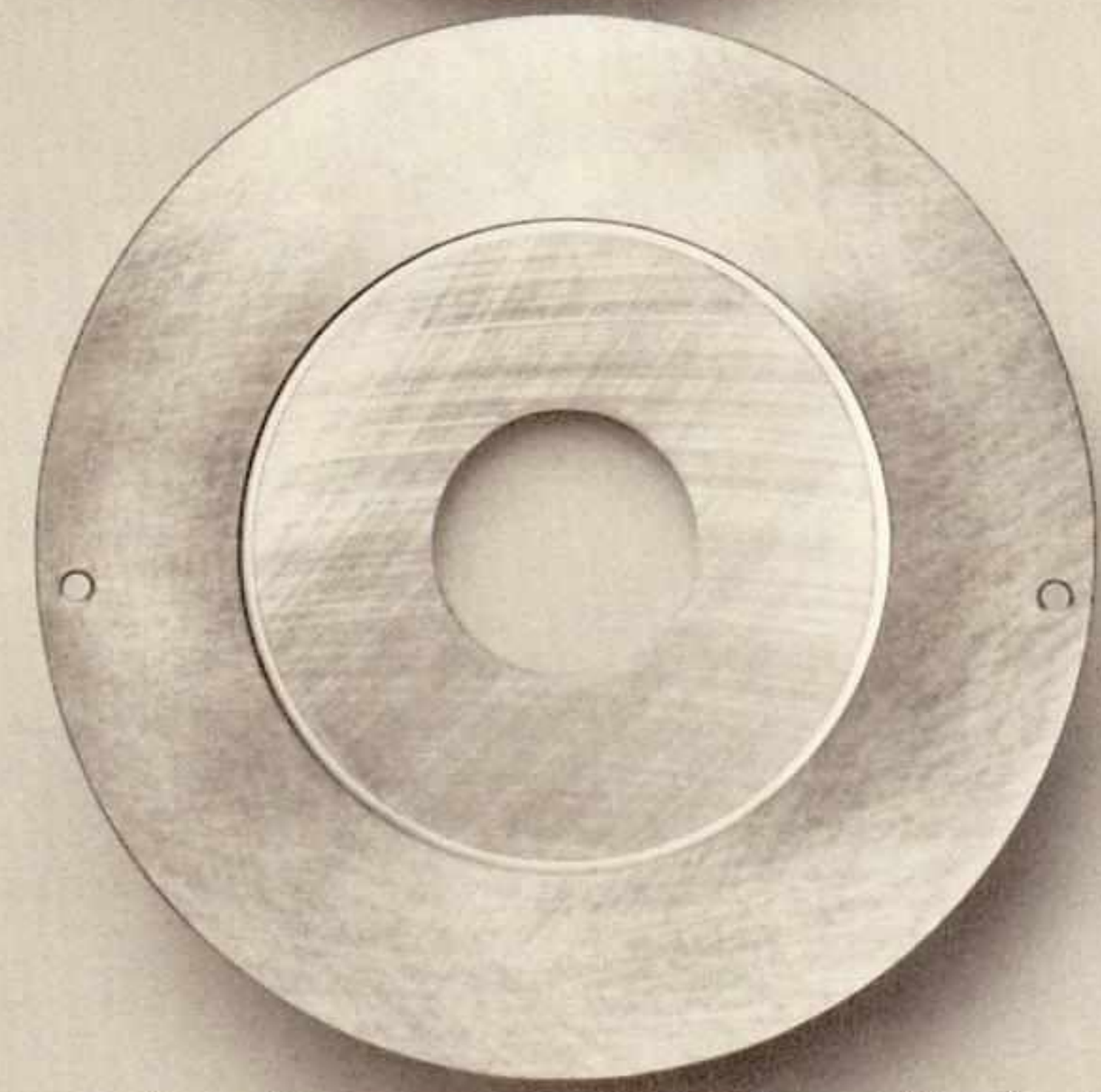
Alnico V, though more expensive, was chosen for the JBL because it has higher energy and the ability to dissipate heat.

The Pole Pieces and Top Plates

Fig. 3

The pole piece and top plate from the average speaker are stamped from flat stock for the sake of economy. The stamping and assembly line fitting of these parts necessitate relatively wide tolerances.

The JBL pole piece and top plate are precision machined for extremely close tolerances and optimum concentricity. The pole piece and top plate are made from magnetic iron.



Together the pole piece and top plate, as seen in this top view photograph, form the voice coil gap in which the voice coil travels. The efficiency of a loudspeaker is to a great degree determined by the amount of energy that can be concentrated in the voice coil gap. Closer tolerances create a more intense magnetic field in the gap. Keeping the gap concentric assures the same intensity of magnetic energy all the way around. If the intensity is unequal, the voice coil may not move linearly.

By using special tooling, roundness of the JBL pole piece and top plate are held within five ten-thousandths of an inch. Optimum concentricity is maintained within two thousandths of an inch. Very exacting standards, but altogether necessary for the degree of efficiency expected of a JBL loudspeaker.

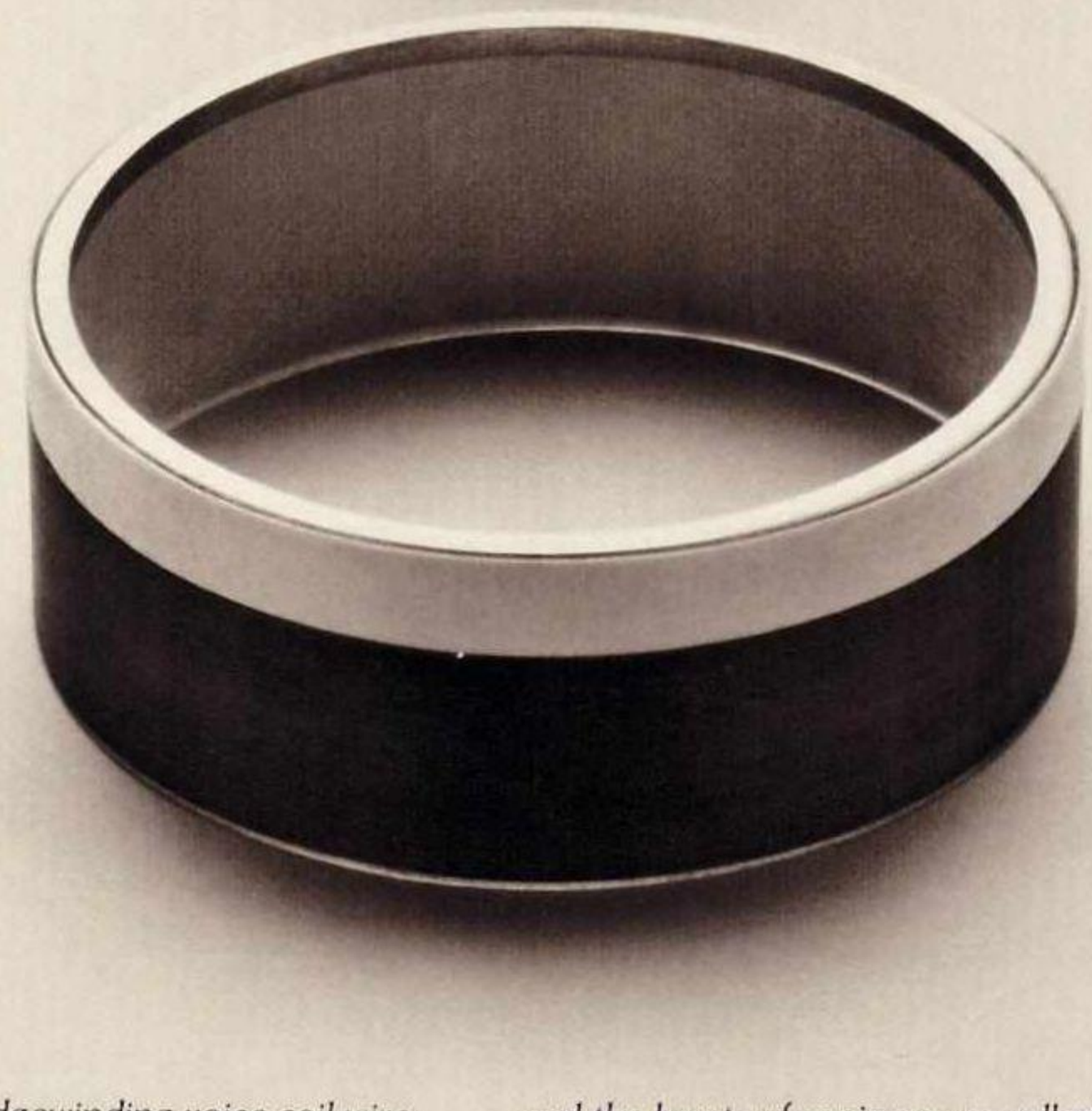
Since the tolerance of the voice coil gap is wider in the typical speaker, efficiency is a problem. Therefore, the diameter of the gap is kept smaller to keep the problem at a minimum.

The drawback of a smaller diameter voice coil gap is that the 1½-inch voice coil—which travels in it—handles less power. The reason is discussed in the following section.

The Voice Coils

Fig. 4

This voice coil is made from round wire and has been wound by machine. It has a 1½-inch diameter and is from the typical speaker.



The voice coil from the JBL loudspeaker is 3-inches in diameter. It is made from copper wire which has been carefully milled into a thin ribbon and wound by hand on its narrow edge. Attached to the voice coil is a concentric, die cast ring, seen at the inside top of the cylinder.

By flattening and edgewinding voice coil wire, illustrated in Figure 6, JBL gets 24% more conductor into the voice coil gap. More conductor into the voice coil gap relates to increased efficiency. The reason that the JBL voice coil has a larger diameter is that an oversized voice coil dissipates heat at a faster rate. Rapid heat dissipation here permits the speaker to handle added amounts of power, both constant power and the bursts of sonic power called transients.

When the JBL voice coil is attached to its cone, the die cast ring fits inside the cone's center hole. That gives the cone structural integrity. It prevents the cone from breaking up and distorting at the higher frequencies, so that the JBL loudspeaker has a very smooth response at its upper end where the transition is made to the midrange transducer.

Fig. 5

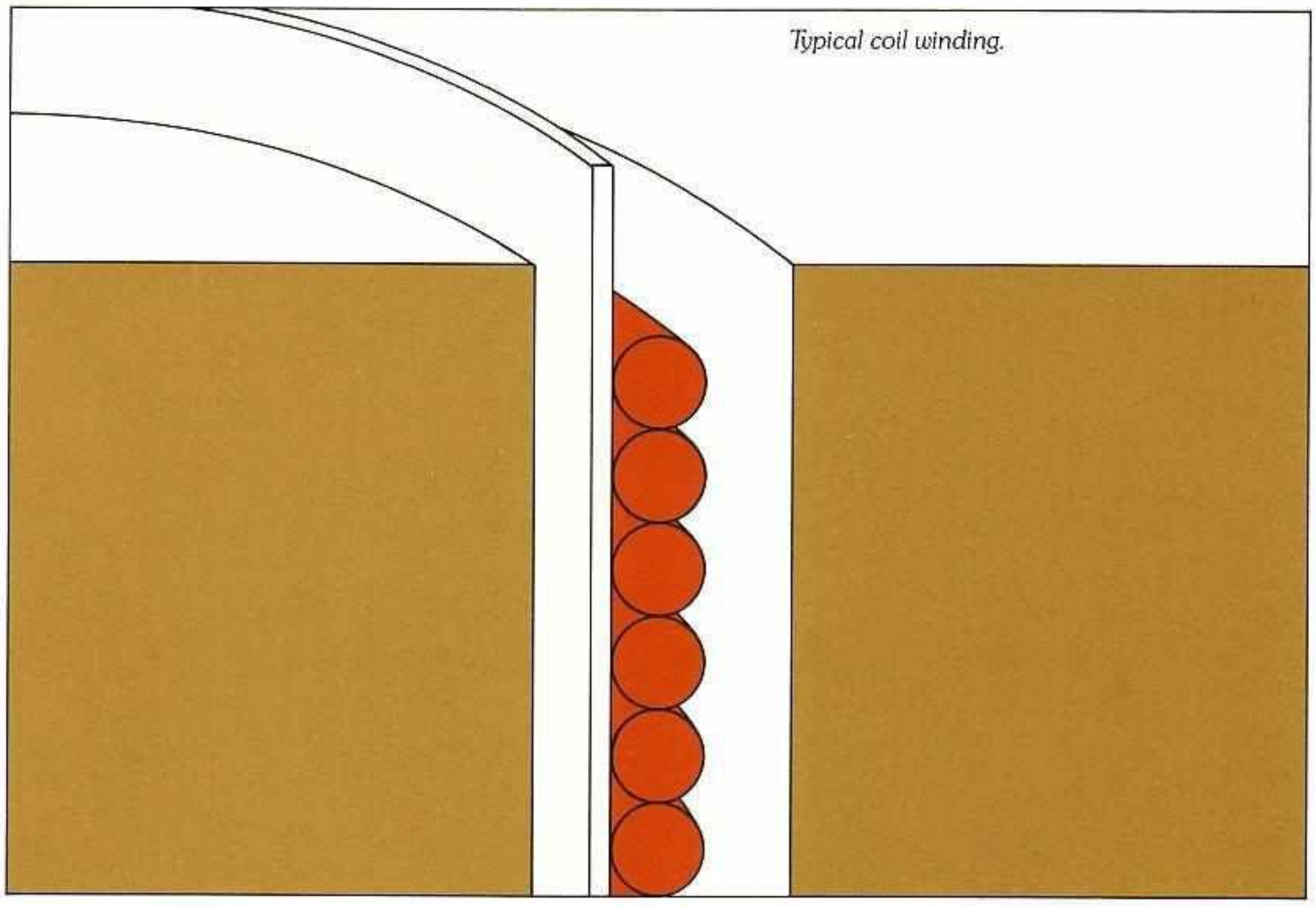
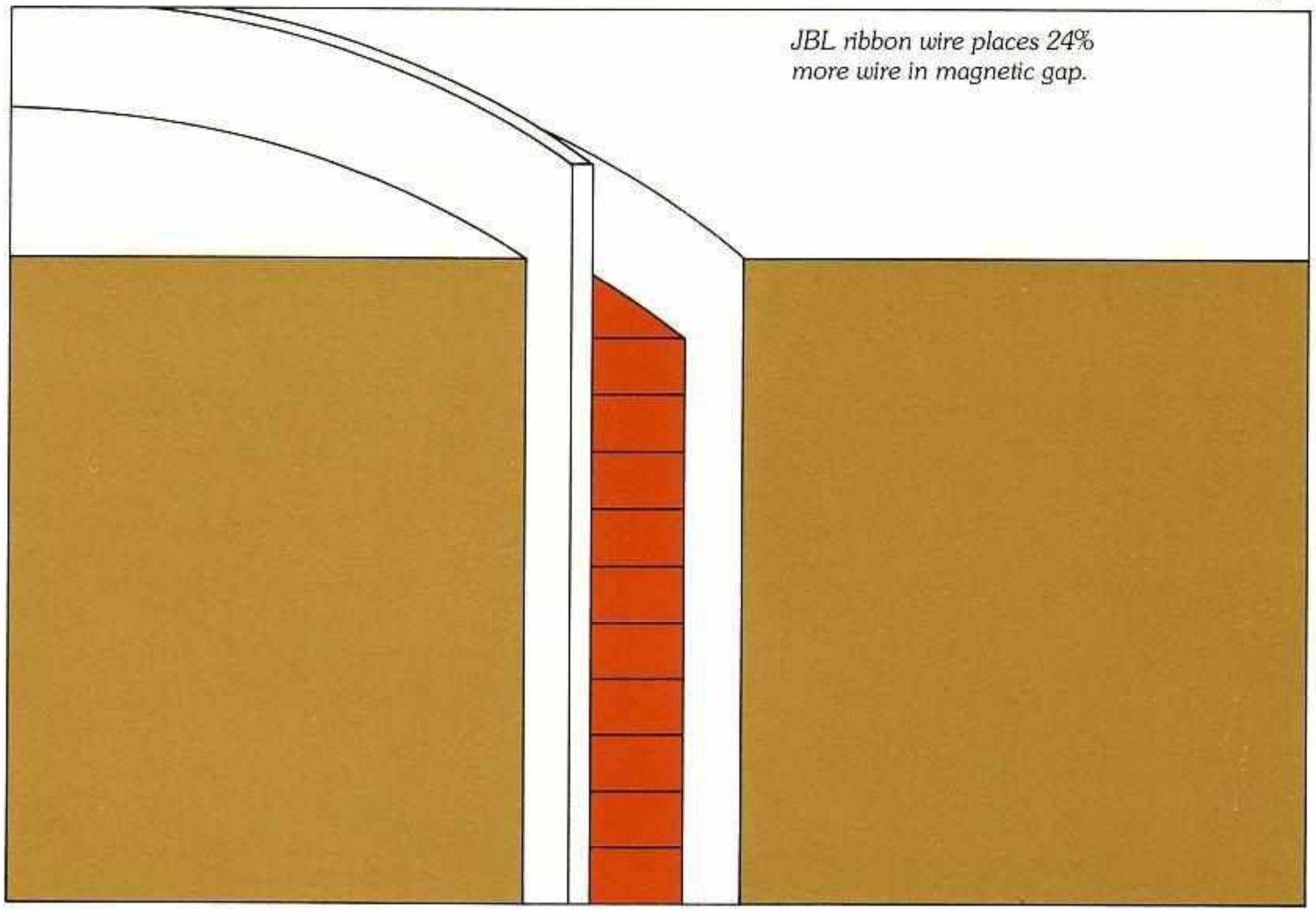

Typical coil winding.

Fig. 6


JBL ribbon wire places 24%
more wire in magnetic gap.

The Cones

Fig. 7

This cone is deeper and is fabricated of softer material. It has a compliance at its edge to connect it to the frame and allow the cone to move linearly.

The JBL cone is relatively shallow. It is specially made of a very stiff and hard material. The compliance on the outer edge serves a similar function.

The cone's role is to act as a piston and push the air in response to electrical impulses applied to the voice coil (see Figure 10). Unless the entire cone moves with the voice coil, response is not uniform. JBL's shallower, stiffer cone resists flexing. The deeper and softer cone has a tendency to buckle when moving, causing distortion.

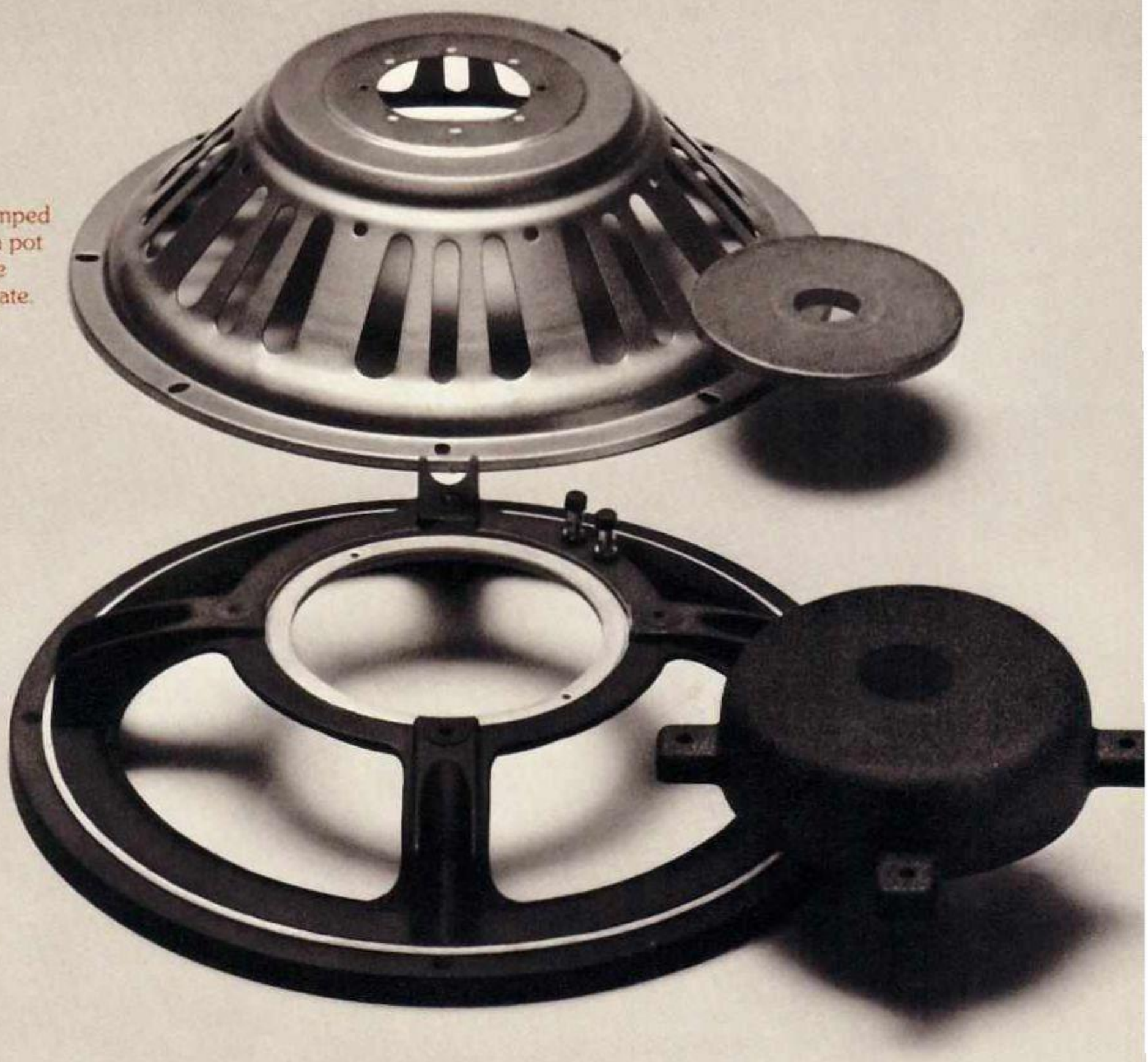
The die cast ring on the JBL voice coil fits inside the center of the JBL cone as previously discussed in the section on voice coils. The ring, for which a patent has been applied, holds the cone rigid and doesn't allow any deformation at the higher frequencies the cone must reproduce.

The Frames and Pot Structure

Fig. 8

The typical speaker uses a stamped sheet metal frame; instead of a pot structure, a stamped back plate holds the magnet to the top plate.

The JBL has a sturdy, cast aluminum frame and a carefully machined, low-reluctance, iron pot structure which encapsulates the magnet.



The stamped frame is subject to warping with age and use. Any change in alignment can result in a coloration of the speaker's response. The JBL cast frame has a structural strength that resists any misalignment.

JBL's pot structure directs all the magnet's energy to the voice coil gap. The open back plate arrangement which is more typical loses much of its magnet's energy off the rear and sides. Evidence of such magnetic loss is that metal objects are attracted to the back plate of a typical speaker. The JBL pot structure has no stray magnetic field. All the magnetic energy is conducted to the voice coil gap where it is supposed to be.

Fig. 9

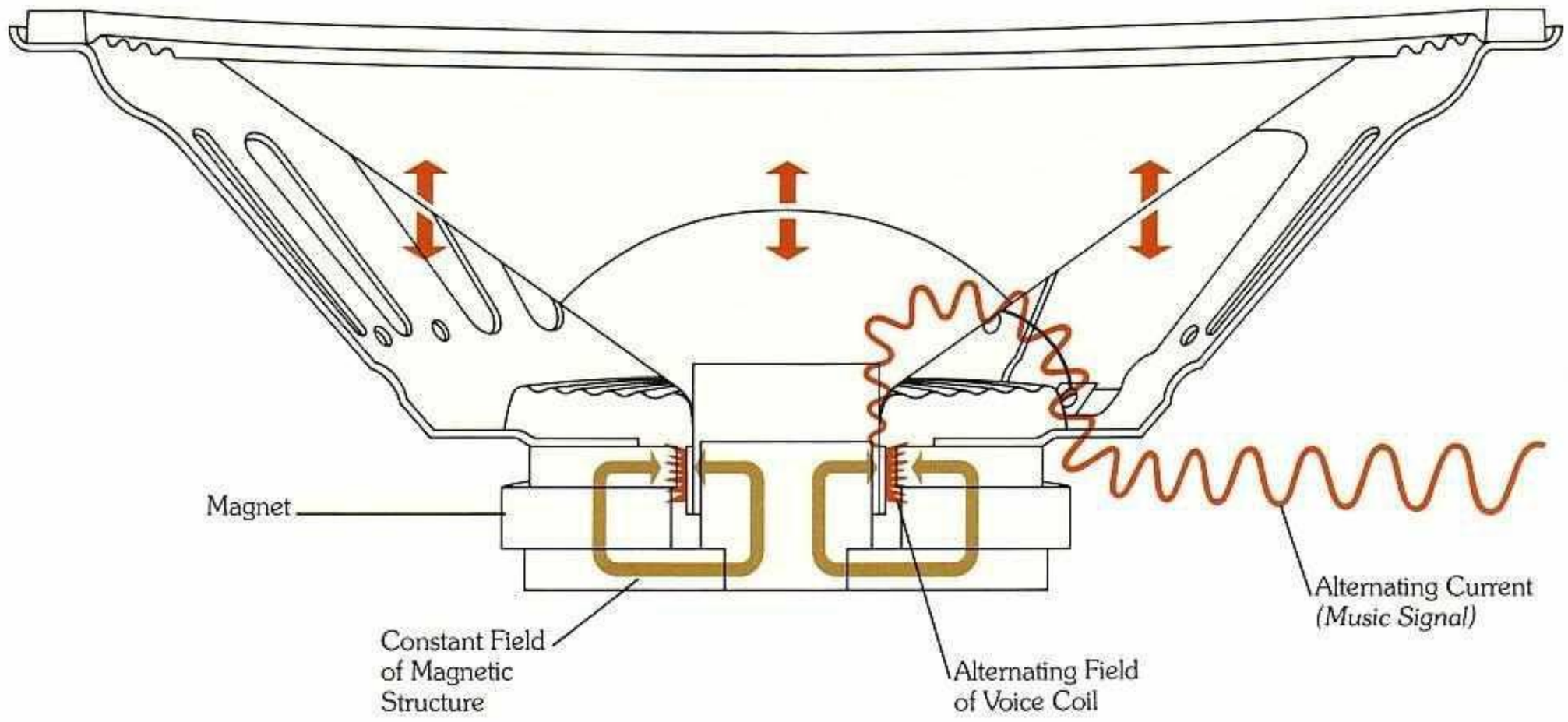
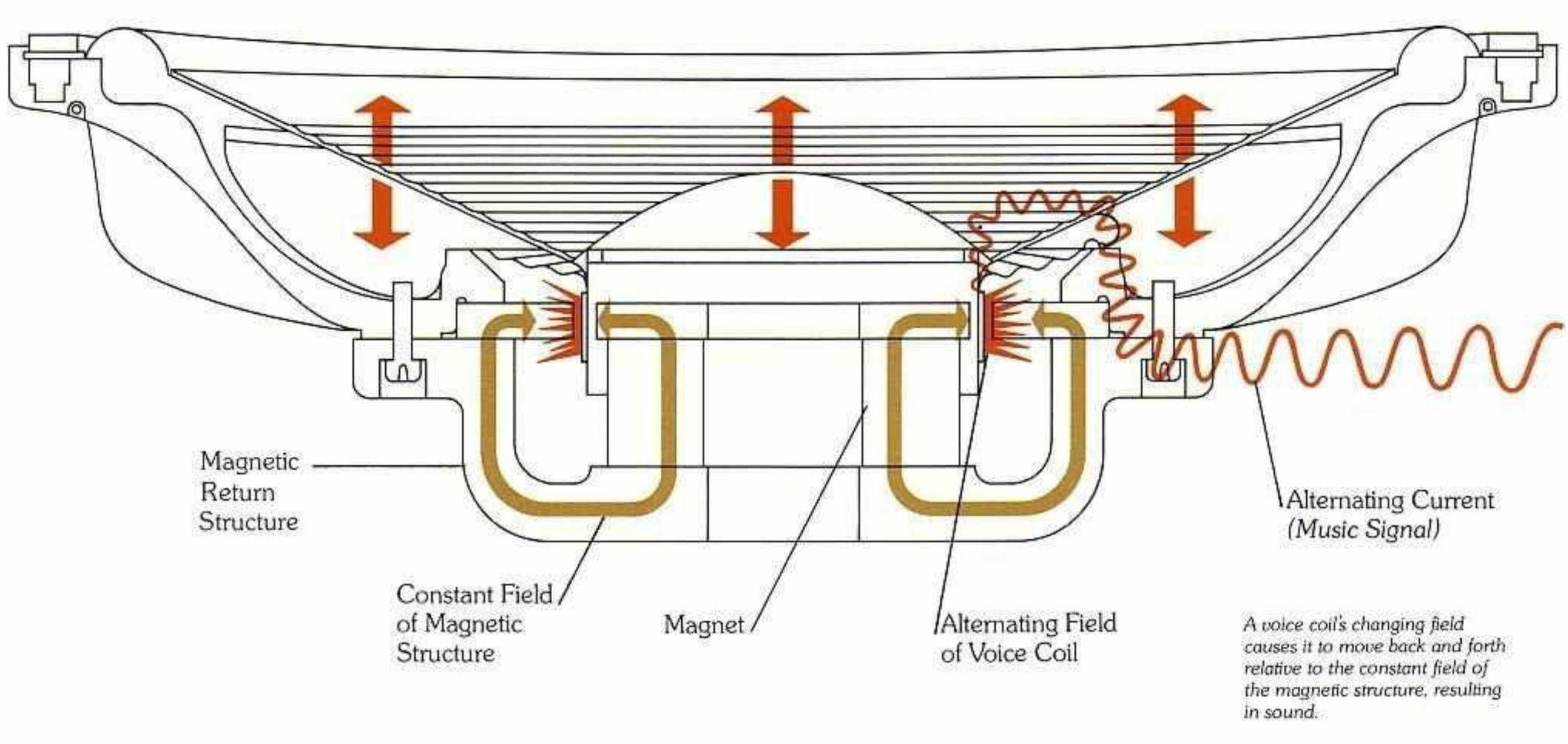


Fig. 10



A voice coil's changing field causes it to move back and forth relative to the constant field of the magnetic structure, resulting in sound.

Can two speakers with such different parts be alike in whole? The answer should be obvious. The JBL has a stronger magnet and precision machined magnetic assembly for more intense energy in the voice coil gap. That translates into increased efficiency for the loudspeaker. The JBL voice coil has a larger diameter for greater power handling. The voice coil is made of edgewound ribbon wire to put more conductor into the voice coil gap. Again, efficiency is the gain. The JBL has a cone with structural integrity to prevent deformations which would color response. The JBL has a stronger frame and a sealed pot structure that does not lose any magnetic energy.

The Whole is Greater

JBL doesn't miss a chance to improve a loudspeaker. That much is evident from this visual inspection of the 126A.

There's an audible difference, too. The JBL 126A has a smoother response, particularly in the transition to midrange. Smoothness there is critical.

On the average, the JBL loudspeaker has a 3 dB greater output than the typical speaker fed the same input. Though 3 dB may not seem a considerable difference, it means that the typical speaker must be fed twice the power to reach the same sound level as the 126A. With increased power comes the risk of increased distortion.

Sophisticated design and care in manufacture pay off not only in enhanced performance of a loudspeaker but also in its longevity. JBL believes that a fine loudspeaker, like a fine musical instrument, should never wear out. We stand behind that belief by offering to repair any JBL transducer free of charge without time limitation if factory inspection discloses evidence of an original manufacturing defect.

JBL could cut corners for economy and still get 90% of the performance and life of the loudspeakers we now produce. That's not the way we think. We're not building speakers for people who are satisfied with 90%.

JBL

James B. Lansing Sound, Inc., 3249 Casitas Avenue, Los Angeles, California 90039. 126A/74 Printed in U.S.A.