HIGH FIDELITY LOUDSPEAKER OF UNIQUE DESIGN

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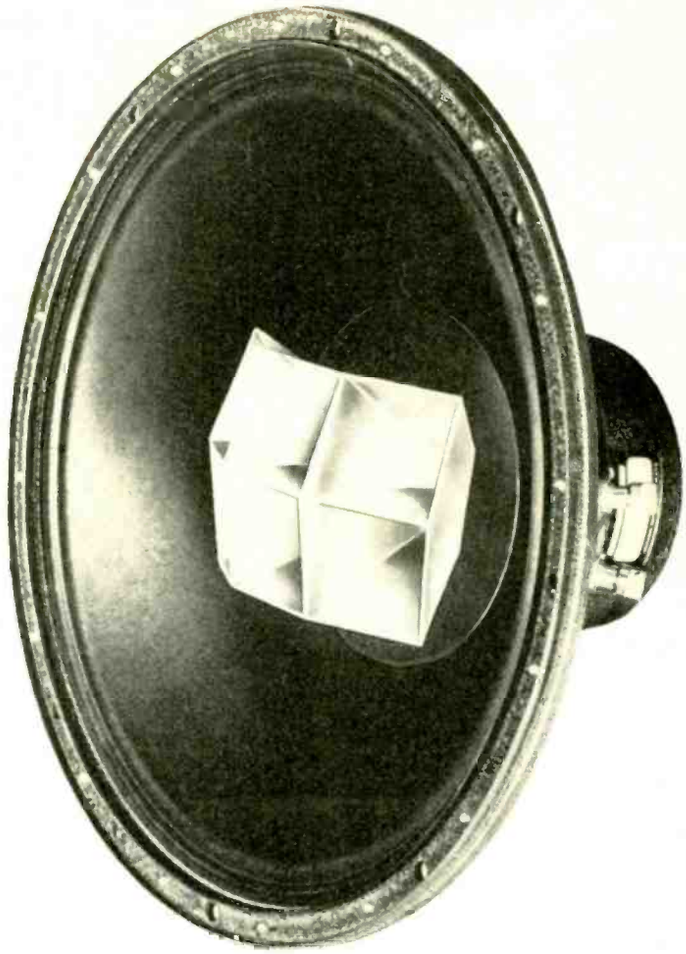

Describing in detail the characteristics of a new type of loudspeaker, shown in Fig. 1 at the right.

A MAJOR HANDICAP to true high-quality sound reproduction has been the electro-acoustic converter at the end of the reproducing system — the loudspeaker — which has all the limitations that go with mechanical systems.

The advent of better records and the promise that full range FM broadcasting will shortly become a country-wide reality has accelerated the demand for loudspeakers having both a wider frequency response and freedom from intermodulation distortion. Several such loudspeakers are available which meet these requirements, but unfortunately their high manufacturing cost has resulted in their being priced beyond the reach of most users.

Dia-cone Principle

In an attempt to provide a lower-priced unit which retains most of the good features of the finest loudspeakers, the design now known as the Dia-cone was developed. The principles involved are relatively new to the loudspeaker field, and the results obtained have made this particular design one which should be considered for applications in which high quality is desired, yet where the cost of the more elaborate models prohibits their use.

The name Dia-cone is derived from "diaphragm" and "cone" and applies to a loudspeaker having both a high-frequency diaphragm and a low-frequency cone driven through a mechanical network by a single large voice coil. The combination thus gives many of the advantages of a true two-way loudspeaker without the accompanying high costs of double magnets, double voice coils, crossover networks, and the additional costs necessitated by a complicated mechanical construction.

The Model 603 (Altec Lansing) Multicell Dia-cone speaker has an over-all diameter of 15-3/16 in. and a depth of 6⅝ in., being sufficiently compact, as shown in *Fig. 1*, to enable its use in standard cabinets when desired. No additional equipment is required for its connection to the output of any good standard amplifier having output impedances designed to match its rated voice-coil impedance of 10 ohms.

Acoustic energy is radiated from two diaphragms which are attached to a single 3-inch voice coil. Since it is recognized that a single large diameter cone-type diaphragm is not capable of providing the necessary uniformity of response over the entire frequency range, the dia-cone type of construction has been employed. At frequencies above 2,000 cps, the mass of the outside cone is large, and, as a consequence, its ability to radiate uniform energy above 2,000 cps decreases rapidly as the frequency range is increased. Attached directly to the voice coil ring is a domed metal diaphragm of the same diameter as the voice coil. This diaphragm has a high stiffness-mass ratio and so is able to operate as a piston even though the large cone on the outside of the voice coil fails to provide the proper excursion. The voice coil and the metal diaphragm vibrate independently of the outer diaphragm at high frequencies because of the compliance in the area immediately outside and adjacent to the voice coil. The vibrating area of the metal dome is small in comparison with the wave lengths of the frequencies being radiated, and for this reason the distribution is efficient up to 8,000 cps. The amplitude of diaphragm excursion for uniform radiation of acoustic power decreases with an increase in frequency, so that considerable acoustic power can be radiated from a 3-inch diaphragm with a comparatively small amount of excursion. At low frequencies, the metal diaphragm moves as a unit with the

large cone, thus providing the maximum possible vibrating area. The efficiency of this speaker is such that it will deliver a level of 89 db (reference level = 0.0002 dynes per sq. cm.) on its axis at a distance of five feet with an input of only 0.1 watt (500-1,000 cps). The electrical power rating is 25 watts.

In order to enhance the distribution pattern over the high-frequency range, a molded bakelite six-cell multicellular horn is mounted directly in front of the metal dome, as shown in Fig. 2. Sufficient clearance is provided so there is no possibility of the metal diaphragm striking the throat of the high-frequency horn even at rated maximum power. The horn is held in position by means of two studs which are threaded into the top plate surrounding the voice coil structure and pole piece, and clearance holes are provided in the outside cone for the studs. In addition to improving the angular distribution, the multicellular horn also reduces irregularities in response.

Cone Design

The cone itself, of seamless molded construction, has an effective radiating area of 123 square inches, and is treated to resist moisture. The domed diaphragm is cemented directly onto the voice coil structure, which is edgewise-wound with aluminum ribbon. This permits an increase in the space factor by 27 per cent over round wire, and since more conductor material can be placed in the air gap, the efficiency is raised and the operating temperature — with higher power — is reduced. The large voice coil permits a decreased cone depth with an increase in effective stiffness to the driving force, so that the cone acts more nearly as a piston at low frequencies. The spider is of the accordion type so as to permit large low-frequency excursions, and is attached to the magnet structure outside the voice coil. The resonance frequency of the cone and voice-coil assembly is approximately 45 cps in free air.

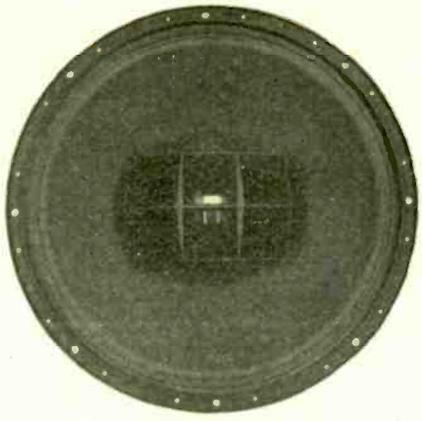

Fig. 2. Front view of the Dia-cone speaker described in this article.

Field excitation is provided by an Alnico V permanent magnet, with the magnetic circuit being so designed that there is very little stray field. This is an advantage when the speaker may be used in proximity to cathode-ray tubes, as in television-radio cabinets.

When using this speaker with amplifiers having negative feedback embracing the output stage, the maximum true bass response can be obtained when the internal output impedance of the amplifier is approximately 10 ohms. It is not sufficient alone that the amplifier be rated for a 10-ohm load, since the use of a large amount of feedback may produce output impedances much lower than the rated load impedance of the amplifier. An output impedance several times lower than the speaker impedance should be used only in connection with loudspeaker cabinets which are of improper design and tend to give boomy reproduction.

Cabinets of the tuned-port type are recommended where the maximum bass response is required in a limited space. Enclosures having a volume of four cubic feet will give efficient response down to 90 cps, where cutoff begins. Low-frequency response is improved with increase in size, with efficient response down to 55 cps being obtainable from a seven cubic-foot cabinet. In any such type of cabinet, the speaker should be mounted as high in the cabinet as possible so the direct radiation will not be obstructed by furniture, and to minimize floor reflection. Port tuning may be resorted to for adjustment of optimum performance.

Cabinet Types

Figures 3 and *4* show two different types of cabinets used with the Dia-cone speaker as available units. The furniture cabinet, *Fig. 3*, has a volume of seven cubic feet, with the port resonated for maximum response down to 55 cps. The utility cabinet, *Fig. 4*, has a volume of approximately six cubic feet, with the port tuned to 60 cps. Both of these cabinets are lined with fiberglass panels, 2 inches thick.

The Dia-cone speaker was designed to supply a superior quality of reproduction for those applications where the added high-frequency response of a duplex speaker may not be necessary, and where the extra cost is not warranted by the use to which the speaker is to be put.

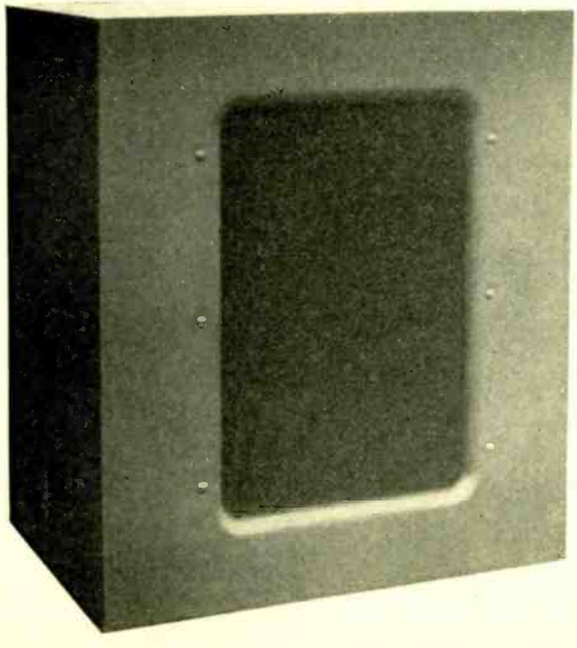

Fig. 3 (right). The loudspeaker is shown installed in the furniture type cabinet.

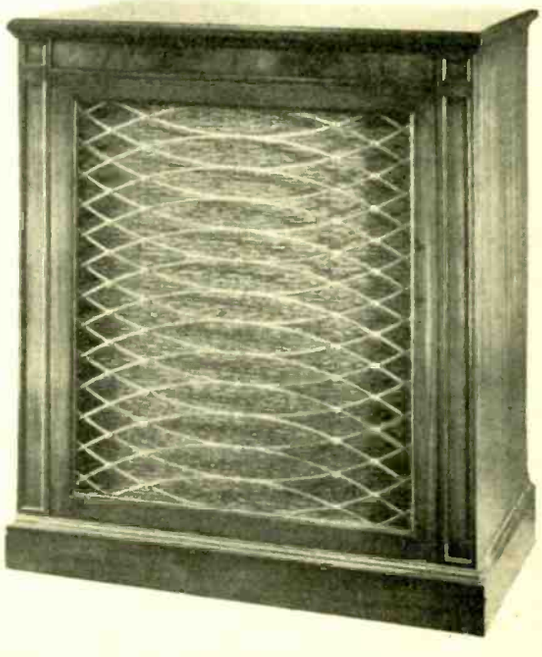

Fig. 4 (left). Speaker installed in utility cabinet.