A CORNER LABYRINTH TRANSDUCER

By
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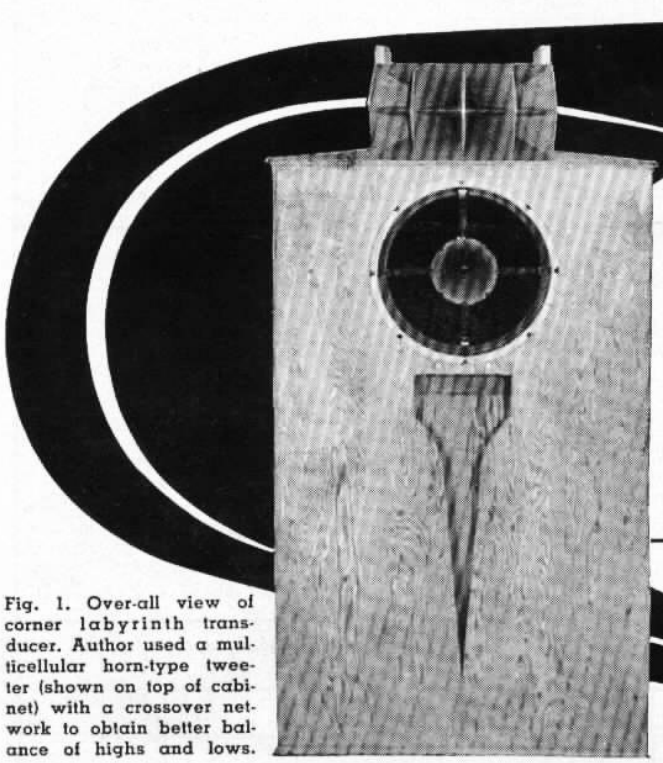

Fig. 1. Over-all view of corner labyrinth transducer. Author used a multicellular horn-type tweeter (shown on top of cabinet) with a crossover network to obtain better balance of highs and lows.

For corner or wall—transducer will provide good low frequency response. Design is for 15" speaker.

LABYRINTH loudspeaker housings have achieved a firm place among the various types of transducers used to reproduce the low frequency end of the audio spectrum. "The general conclusion is that the acoustic labyrinth gives better bass than the reflex cabinet . . ."[1] ". . . rock-like steadiness and was considered superior to a similar reflex cabinet . . ."[2] ". . . they sound pretty good. Possibly a bit better than an infinite baffle. At least on a par with them."[3] ". . . accentuated response due to cabinet resonance has been eliminated . . . the low frequency range has been extended."[4]

The labyrinth loudspeaker cabinet to be described is fairly compact and is shaped to fit into a corner of a room; it has a flat back so that it may also be placed against a wall. Its over-all dimensions are 30 inches wide, 48 inches high, and 11 inches deep. It is designed for use with a 15-inch loudspeaker which may be of the coaxial type. Unlike most labyrinth cabinet designs, the present cabinet provides balanced loading on the rear side of the speaker cone.

Fig. 1 is a photograph of the cabinet. Fig. 2 shows the path of sound from the rear of the speaker cone through the labyrinth, and Fig. 3 shows construction details.

A labyrinth cabinet employs direct radiation from the front of a loudspeaker cone, and loads the rear of the cone with a length of labyrinth tube or pipe which may be folded to achieve compactness. The labyrinth should have about the same cross-section area as the speaker cone.

Both closed-end and open-end labyrinths are used; the latter is preferable because it avoids a totally closed enclosure which might tend to cause air pressures to be built up within the enclosure, resulting in distortion and a lack of "liveliness" of response. A totally enclosed cabinet might be referred to, in a derogatory manner, as being a "pressure-box," just as bass reflex cabinets are sometimes referred to as "boom-boxes." It is only fair to acknowledge, however, that a closed speaker cabinet having a sufficiently large volume will overcome the "pressure-box" objection, and a properly designed bass reflex cabinet will minimize the "boom-box" effect.

Types of loudspeaker housings that are not afflicted by "pressure" and "booming" effects are the large open baffle, the exponential horn, and the open-ended labyrinth. Of these, the open-ended labyrinth has the desirable qualities of being relatively compact and easy to construct. As to compactness, the labyrinth cabinet here described has a 6-foot path from front-to-back of the speaker cone, and is thus equivalent to a 12-foot diameter flat baffle in this respect.

The length of an open-ended labyrinth should be equal to one-quarter of a wavelength of the cone resonant frequency; for a speaker having a 50-cycle cone resonance, the labyrinth length should be about five and a half feet. The labyrinth loading will then reduce the "boom"-producing amplitude hump which tends to occur at the cone resonance frequency. The labyrinth loading also is effective to extend and aid frequencies that are lower than the cone-resonant frequency.

The advantages of placing the loudspeaker in a corner of a room are well known.[5] The presently-described cabinet is shaped with 90-degree sides for easy corner placement. The labyrinth has a maximum length of 6 feet, which is correct for a loudspeaker having a cone resonance frequency of 45 cycles.

The open end of the labyrinth is tapered over a distance of two feet, as shown in the photograph and drawings, in order to have an effective labyrinth length of from 4 to 6 feet; the tapered opening is approximately exponential with its widest end at the longest length of the labyrinth. The exact shape of the tapered opening is not believed critical. The opening, being wider at the longer wavelengths of labyrinth-loaded sound, favors the lower-frequency portions of the loudspeaker response. The broadband effect of the taper is found to provide very good loading over a wide range of cone resonance frequencies. Loudspeakers having cone resonances ranging from 40 cycles to 65 cycles have operated satisfactorily.

By way of comparison, a square opening was tried, instead of the tapered opening, at the end of the labyrinth. The bass response then seemed somewhat "tight" and "confined." After changing to the tapered shape, the lower bass range seemed "free and easy" and more "alive." The tapered labyrinth opening thus provides two beneficial effects: smoother bass re-

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sponse with the speaker used, and ability to properly load different speakers having different cone-resonance frequencies.

When assembling the cabinet, it was found advisable to first cut out and assemble the front, back, and sides. The top, bottom, and inserts can then be measured and cut to fit accurately; the dimensions shown in Fig. 3 can serve as a guide. The entire cabinet is constructed of half-inch thick plywood, which is thick enough since there is no appreciable air pressure built up in the cabinet during operation. The inserts, being attached between the front and back pieces, add strength to the structure.

The parts of the cabinet are fastened with glue and wood screws. The bottom, however, is not glued, so that sound-absorbing material may be inserted or removed. It was found that completely lining the inside of the cabinet with one-inch thick rockwool seemed to reduce the "liveliness" of response; best results were obtained with the lining on two adjoining sides throughout the length of the labyrinth.

The loudspeaker is mounted from the front of the cabinet; thus the top can be firmly glued down. In the model constructed corner pieces were attached inside the cabinet at each folding of the labyrinth, in order to provide a constant cross-sectional area through the length of the labyrinth. Considerable effort and cut-and-try was required to do this; the refinement is not believed worthwhile unless one is particularly adept at carpentry. For decorative effect, the front of the cabinet may be covered with a large piece of grille cloth and the top and bottom pieces can be varnished or painted.

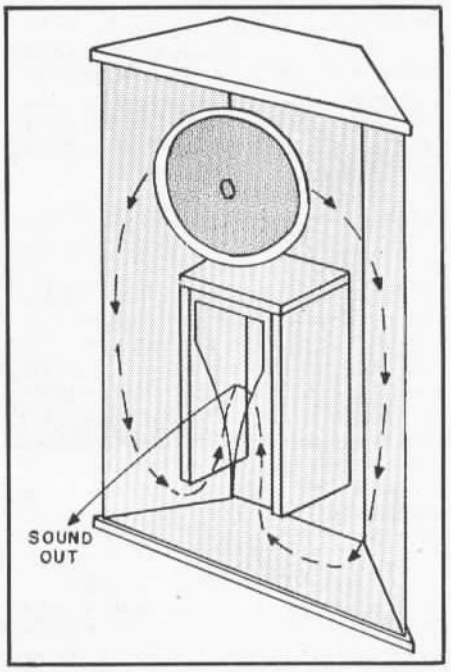

Fig. 2. Sound path from rear of speaker cone.

REFERENCES

1, 2. Briggs, G. A.; "Loudspeakers," Wharfedale Wireless Works, 1948. Pages 50, 78.

3. Langham, J. R.; "High-Fidelity Techniques," Radcraft Publications, 1950, Page 21.

4. Olson, H. F.; "Elements of Acoustical Engineering," D. Van Nostrand Company, 1943, Page 133.

5. Henney, Keith; "Radio Engineering Handbook," Third Edition. McGraw-Hill Book Company, Inc., Page 921.

Fig. 3. Construction details on corner labyrinth transducer. Design is for 15" speaker.