Horn Loudspeaker—Mk II

by John Greenbank *

When details of the first version of the low-cost horn loudspeaker† were published the design had proved itself but the appearance of the system left a lot to be desired. Of course, any would-be constructor who grasped the essentials could make numerous superficial alterations, but the width of the treble horn was something of an embarrassment.

It was decided therefore to proceed with further investigations with a view to streamlining the appearance. The first step was to abandon concrete. For several reasons concrete is almost the ideal material, but at domestic listening levels, where pressure changes in the system are relatively small, the structural elasticity of a well-made plywood horn should be of little consequence. If the bass horn is constructed for low-frequency reinforcement in a large hall, say when used with an electronic organ, it might be sensible to use heavily braced chipboard or even the original concrete version.

Other changes in the system are as follows—

1. reduction of the internal width of the bass horn to that of the driver chassis diameter;
2. reduction in depth of the bass horn;
3. reduction of treble horn width by trimming the sides of the horn but maintaining the length according to the expansion law involved; and
4. modification of the crossover circuit giving improved high-frequency performance.

Construction of bass horn

The front, the sloping top and bottom, the back 'corner' panels and the speaker board are made from 12mm plywood. The front panel is removable. Other wood items can be 9mm ply. All joints should be made with a p.v.a. adhesive such as Evostik Resin 'W'.

Structural details are given in Fig.1. In this version the Fane 122/12 driver is

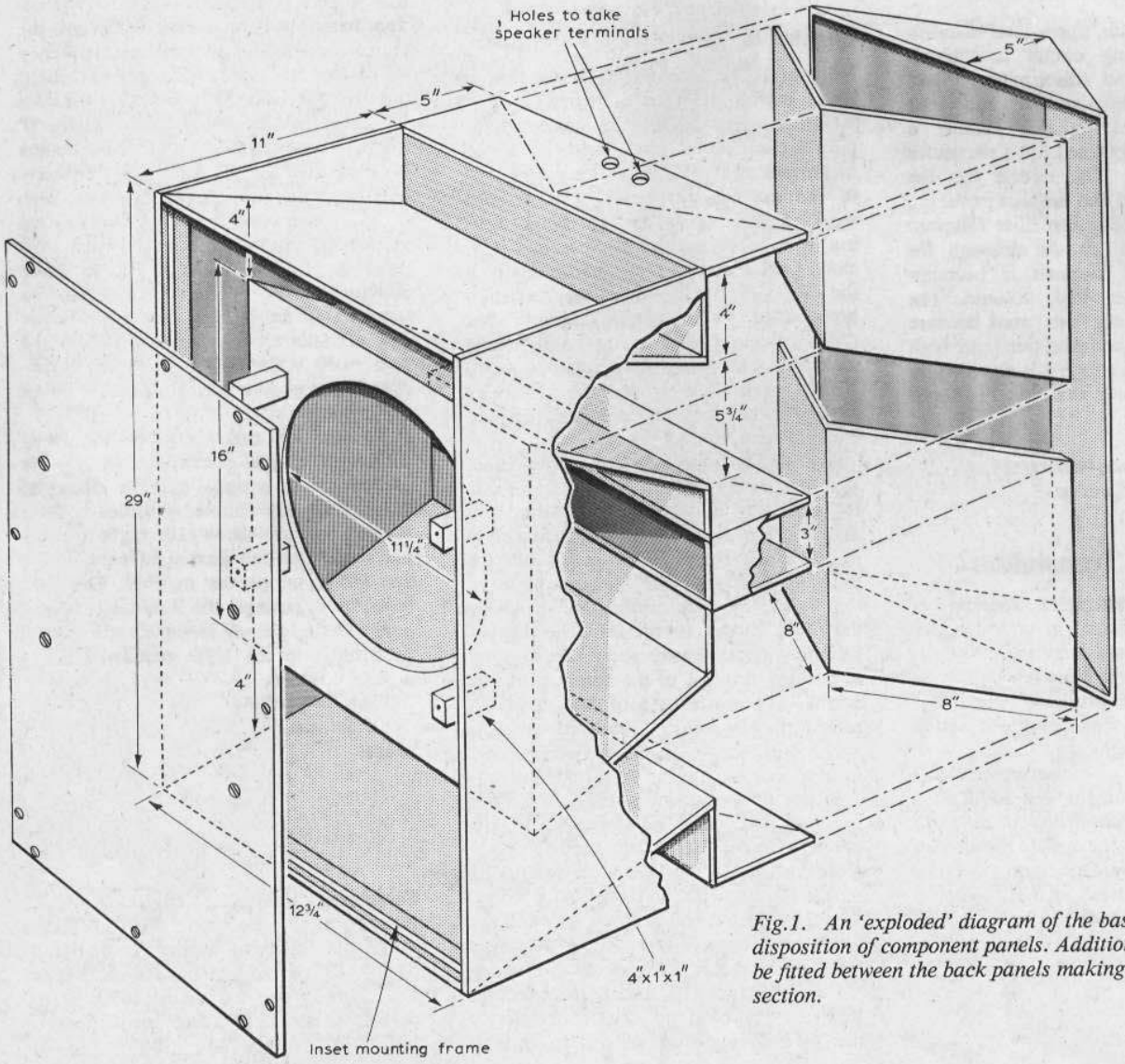

Fig.1. An 'exploded' diagram of the bass horn showing disposition of component panels. Additional bracing should be fitted between the back panels making up the corner section.

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† 'Low-cost horn loudspeaker system', 'Toneburst', *Wireless World*, May 1970. Tearsheets of this article are still available price 12½p.

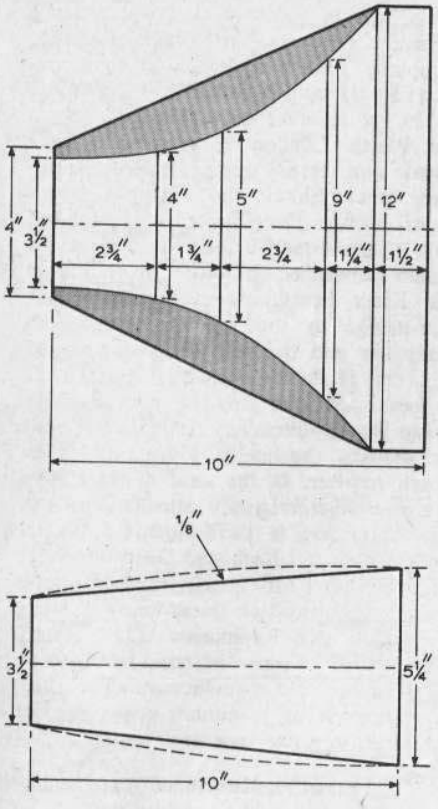


Fig.2. Details of wood sections used in constructing the treble horn. The side sections should be cut along the curve shown dotted (see text).

mounted from the front against a strip of rubber which should be fixed on the front of the board round the edge of the 11¼ in diameter hole to provide an air-tight seal. The front panel does not need a seal but the inset 1 × 1 in mounting frame should be firmly glued in place, and will need chamfering in the top and bottom positions.

Before the triangular corner section is attached, airtight speaker terminals should be fitted. Connecting wire is soldered on and fed through the back-of-cone chamber out through the hole in the speaker board. The wire should be soldered to the tags on the drive unit and the drive unit screwed down tightly.

Four 4 in bracing posts, cut from 1 × 1 in wood should be stuck on to the speaker board, round the drive unit, using p.v.a. adhesive. When the joints are dry paint the ends (with poster paint for example) and press the front panel up against them. Remove the panel, mark its top, and drill through at the centre of each area of transferred paint. The edges of the front panel should also be drilled, as shown in Fig. 1, and the panel screwed into place.

This completes the bass section.

Construction of treble horn

As in the concrete version the horn has flat top and bottom and curved sides. Fig. 2 gives details for the cutting of the sections. Taking the top and bottom pieces first each piece can be cut from a rectangle 10 × 12 in, and 12mm ply should be used. Each six-sided piece of wood should be marked up as shown and the curves constructed. The areas shown shaded will lie outside the horn when it is finished.

The curved sides of the horn should be cut from a flexible plywood such as bending ply. The cutting should follow the dotted curve so that the side can be glued vertically along one of the curved lines drawn on the top or bottom panel. The joint should be made using an 'impact' adhesive as the wood will be under stress. The remaining flat panel can be matched up and similarly fixed in place.

Throat section. Cut a 3½ in diameter hole in a 4in square piece of 5mm ply (not shown in Fig.2) and glue it in place over the throat end of the horn. Fill the inside of the throat region with Polyfilla (interior grade of course) the four 'fingers' of plaster stopping about 3½ in from the throat. This procedure provides the correct exponential transition from circular to rectangular cross-section.

When the Polyfilla is dry give the inside of the horn a layer of undercoat and a couple of layers of gloss paint. The Eagle FR4 drive unit can be fitted to complete the treble horn.

Crossover circuit

The modifications to the bass horn have reduced its efficiency. Advantage is taken of this in that the attenuating resistors in series with the FR4 are bypassed with a small capacitor to boost the top and compensate for the somewhat reduced efficiency of the horn at high frequencies. The series network is shown in Fig. 3.

Winding the chokes. A 2 in piece of ⅜ in diameter ferrite rod (with cardboard discs glued on at the ends) can be wound with 37ft 6in of 24 s.w.g. enamelled copper wire. The turns should be close and the layers neat. The ferrite rod is available in 4 in and 6 in lengths from G. W. Smith (Radio) Ltd. To break the rod, first file a shallow notch. Place a pin on a hard surface, such as a metal ruler, and with the notch facing upwards press the ends of the rod downwards with the pin lying exactly below the notch. This should result in a clean break.

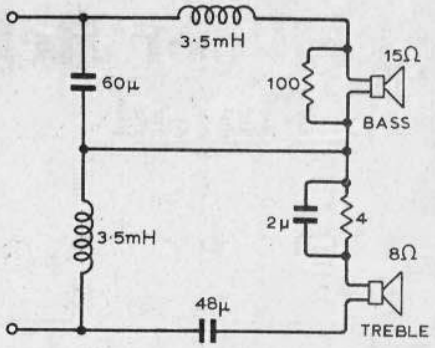


Fig. 3. Crossover circuit using a ½-section series network. Resistors can be ½W.

Capacitors. The reversible 50V electrolytic capacitors used are available from K.E.F. Electronics Ltd, of Tovil, Maidstone, Kent. 60μF capacitors are available but the 48μF required on the treble side is made up from 3 × 16μF units. The prices are 48p per pair for the 16μF, and 68p per pair for the 60μF units.

Horn performance

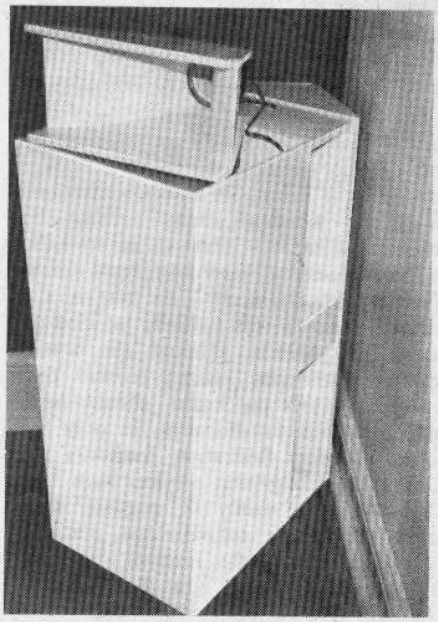
The system described (which was demonstrated at the Audio Fair) will work perfectly if the bass horn is placed in the corner up against the two walls. However, a gap of up to four inches will result in no significant change in performance. The treble horn can be turned round to alter the apparent direction of the sound.

Because very few loudspeakers are capable of launching plane waves at mid-range frequencies few listeners ever hear really good stereo. It is a characteristic of a well-designed radial horn (and a well-designed flat electrostatic radiating element) that the pressure contours have flat fronts. The intersection of two such wavefronts, provided by loudspeakers angled in toward the listener, produces a stable stereophonic image. Constructors of a pair of horns for stereo reproduction will find that they can move freely about in their listening room in the same way that they can move about at a live recital.

Of course, the type of radiation pattern described is a *sine qua non* for worthwhile quadraphony.

Overall efficiency of the system is such that it is unlikely to be overdriven in domestic use, even at high sound levels, when used with a 10W-per-channel amplifier.

A provisional patent application has been filed on aspects of the system.



A finished speaker in its corner.